THE ELECTRICITY RESOURCE PLAN

Choosing San Francisco's Energy Future

solar

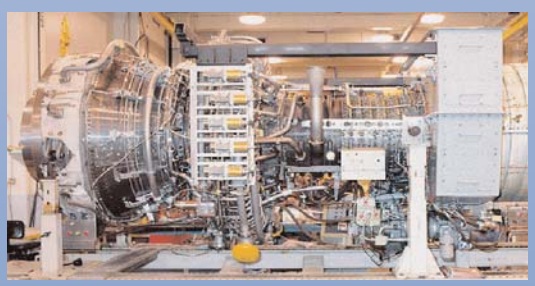
tidal energy

biomass

wind

efficiency

cogeneration



San Francisco Public Utilities Commission

San Francisco Department of Environment

Revised December 2002

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Preface

This revised edition of *The Electricity Resource Plan* updates emissions forecasts based on the most recent analysis and projections. Minor edits have also been made in the text where appropriate.

The Plan was adopted by the Board of Supervisors and signed by Mayor Willie Brown in December, 2002 as a policy guide to be used in proposing and implementing specific actions. Those actions that require the expenditure of CCSF funds or require compliance with environmental laws will likely require additional analysis and public review. This Plan provides a long-term vision of the City's possible electricity future. Because the Plan extends over a ten-year time horizon, it will need to be adapted and revised to accommodate changing circumstances.

Implementation of the Plan will require the cooperation of many organizations, including but not limited to the California Public Utilities Commission, the California Independent System Operator, the California Energy Commission, the California Power Authority, Pacific Gas and Electric Company, independent power developers, energy service companies and other departments and agencies of the City and County of San Francisco. The Department of the Environment and the Public Utilities Commission will periodically release updates on developments that bear on the Plan and will publish a revised edition annually on their web sites.

Acknowledgments

The Electricity Resource Plan is the result of a collaborative effort initiated by Supervisor Sophie Maxwell in early 2001, when she introduced an ordinance to address the health and environmental consequences of electricity generation in the City.

The Plan was prepared by Ed Smeloff of the Public Utilities Commission and Cal Broomhead, Danielle Dowers, and Ann Kelly of the Department of the Environment. Ongoing guidance and support from Greg Asay of Supervisor Maxwell's office and Theresa Mueller and Jackie Minor of the City Attorney's office steered the Plan to completion. Consultant Joel Swisher of the Rocky Mountain Institute provided technical and strategic analysis.

The development of the Plan involved an extensive public process. Comments from San Francisco residents and business representatives helped to shape the goals and to identify strategies for achieving them. Special thanks are due the communities of Southeast San Francisco, whose members worked diligently to see that their important concerns were given full consideration. The collaboration among City departments and community representatives will continue as the implementation stages of the Plan get underway.

Executive Summary

California's experiment with electricity deregulation and the energy crisis it spawned exposed the vulnerabilities of San Francisco's electrical supply and highlighted environmental justice issues associated with fossil fuel generation. The City's electricity is supplied by two old and polluting power plants at Hunters Point and at the base of Potrero Hill, and through overhead and underground transmission lines along a single pathway in San Mateo County. For years communities in the Southeast, where there is a high level of respiratory disease, have been calling for the shutdown of the Hunters Point plant. In 1998 PG&E and the Mayor signed an agreement to close the plant as soon as replacement power was available to assure reliability.

In 1999, as part of the deregulation process, PG&E sold its power plant at Potrero to an out-of-state merchant energy company. Mirant, the new owner, decided to expand the facility by adding a new power plant more than twice the size of the existing plant. That proposal has met with strong community resistance and has raised further alarm about environmental justice in neighborhoods bordering fossil fuel plants.

The City's Board of Supervisors responded to this situation in May 2001 by unanimously passing an ordinance, "Human Health and Environmental Protections for New Electric Generation," introduced by Supervisor Sophie Maxwell, who represents both the Hunters Point and Potrero neighborhoods.[1] The ordinance directs the San Francisco Public Utilities Commission (SFPUC) and the Department of the Environment (SFE) to prepare an energy resource plan that considers all practical transmission, conservation, efficiency and renewable alternatives to fossil fuel electricity generation in the City and County of San Francisco.

This Plan presents a framework for assuring reliable, affordable, and sustainable sources of electricity for current and future generations with the following notable milestones:

a) By 2005, the City will enable the closure of the oldest of San Francisco's fossil fuel plants at Hunters Point and the reduced operation of the second oldest plant at Potrero. This will be accomplished by developing sufficient replacement power through a combination of peak load reduction, energy efficiency, renewable energy, and new clean technology generation.

b) Following 2005, the large Potrero power plant can be shutdown with the development of transmission projects already being planned or the construction of additional renewable or clean energy technology in the City. This Plan assumes there will be no need for the construction of a large central generation plant in San Francisco.

c) Beginning with the closure of the Hunters Point power plant and throughout the planning horizon of this Plan, greenhouse gases will be reduced. The operationally

[1] Text of the ordinance appears in Appendix A.

flexible natural gas-fired power facilities proposed in this Plan will allow for gradual displacement of existing fossil fuel generation by increased energy efficiency and renewable energy technologies, with a long term goal of zero greenhouse gas emissions and minimal environmental impacts from the generation of electricity.

If these milestones are met, San Francisco will have reduced its in-City fossil fuel capacity as well as its air pollution emissions. Figure ES1 shows that the net decrease in fossil fuel use results in a 72% drop in in-City NOx levels by 2005.

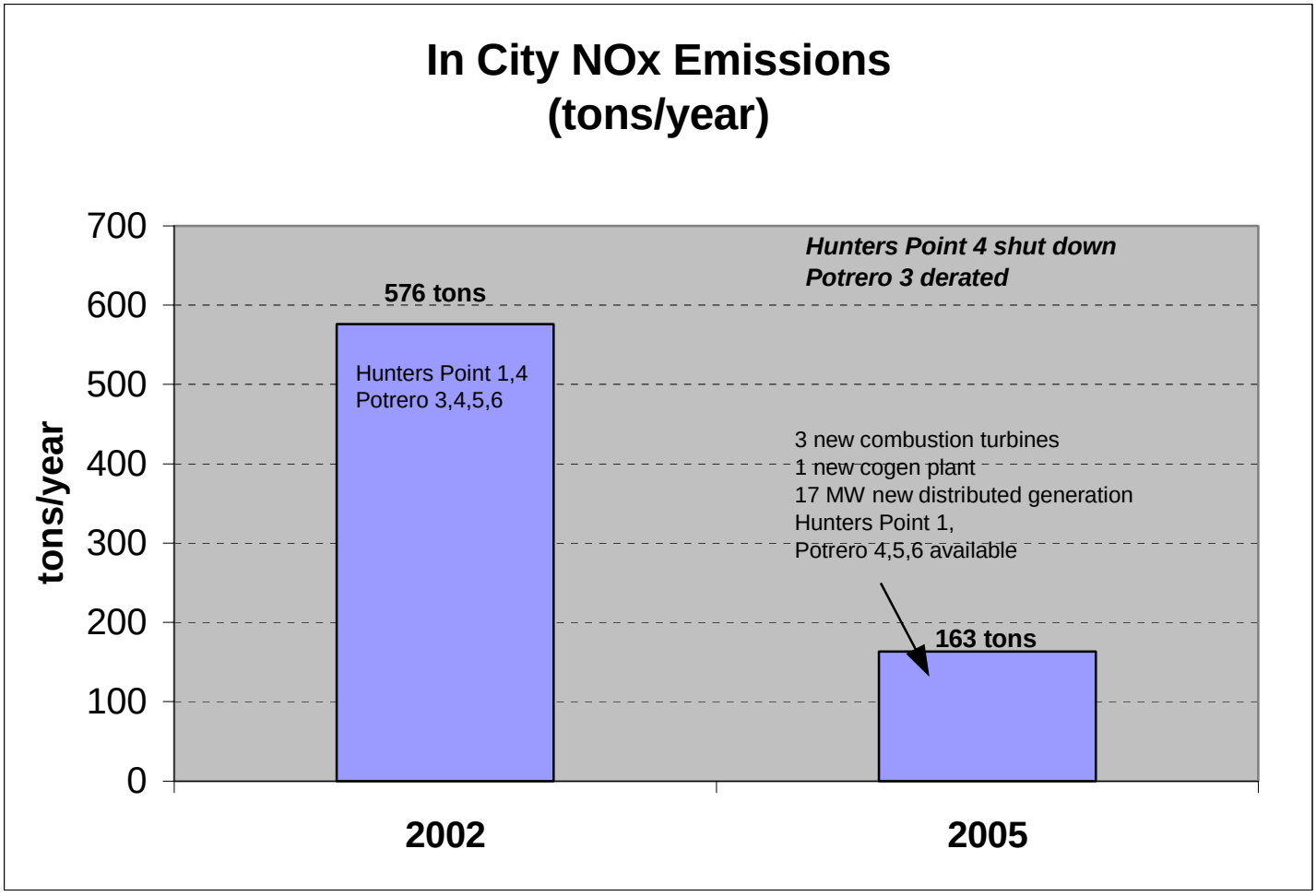


Figure ES.1

Goals

During a series of public hearings, the following goals were identified to set priorities for this Plan:

Maximize Energy Efficiency
Develop Renewable Power
Assure Reliable Power
Support Affordable Electric Bills
Improve Air Quality and Prevent Other Environmental Impacts
Support Environmental Justice
Promote Opportunities for Economic Development
Increase Local Control Over Energy Resources

Key Issues

San Francisco is a constrained transmission area because of its location at the tip of a peninsula. During periods of peak demand, the City can import over existing transmission lines only about 60 percent of the power needed to meet its needs. Therefore, the California Independent Systems Operator (ISO) requires that power plants located in the city be operated to satisfy and maintain grid reliability. The existing power plants are now past normal operating life, inefficient, prone to failure, and many times more polluting than new power plants.

The Hunters Point and Potrero communities consist of a high proportion of lower-income, predominantly non-white residents. These communities share a common concern for public health, especially that of children and the elderly, who are hospitalized for asthma and other diseases at higher rates than reported statewide. Air pollution is a contributing factor to these health problems. The Hunters Point and Potrero power plants, along with vehicles and industrial facilities, are sources of air pollution.

Potrero Unit 3 and Hunters Point Unit 4 are subject to significant NOx emission limitations beginning in 2005. The Potrero Unit falls under a NOx emissions "bubble" that applies to multiple boilers owned by Mirant in the greater Bay Area. Air regulations require that power plant owners operate their fleet of boilers to meet an average NOx output. Mirant is currently evaluating alternative strategies for meeting these air regulations. One possible approach includes scheduling an extended outage of Potrero Unit 3 in 2004 to allow for pollution control retrofits. Given the current set of power resources available, such an outage would make the city more dependent on the Hunters Point Unit 4 and four diesel-fueled peaking power plants for reliability in 2004. The peaking plants are limited to 877 hours of operation because of their high level of pollution.

PG&E has indicated its desire to close the 44-year-old plant at Hunters Point and not to invest in emission reduction retrofits to meet the 2005 standards. If forced to remain open beyond 2004 for reliability purposes, PG&E expects to operate Hunters Point

without new emission controls using emission reduction credits for NOx. Given these circumstances, it is extraordinarily important that the City develop a flexible short-term plan that will diminish, rather than increase reliance on Hunters Point and allow for the closure of Unit 4 by 2005.

Both the proposed Mirant power plant (Unit 7) and a proposed PG&E transmission line on the peninsula (Jefferson to Martin) could provide sufficient additional load serving capacity to allow for the closure of Hunters Point. However, there is significant uncertainty as to when either resource could be available, but definitely by 2005. Therefore, the City needs to develop sufficient credible generation and load reduction alternatives that can be implemented by 2005.

Complicating San Francisco's vulnerable power situation is the state of flux California finds itself in as a result of its failed electricity restructuring scheme. Responsibility for planning for future electricity needs has been diffused through myriad state and federal agencies and the private sector. Consequently, the development of new electricity resources including generation, transmission, and load reduction are not being considered in a comprehensive fashion.

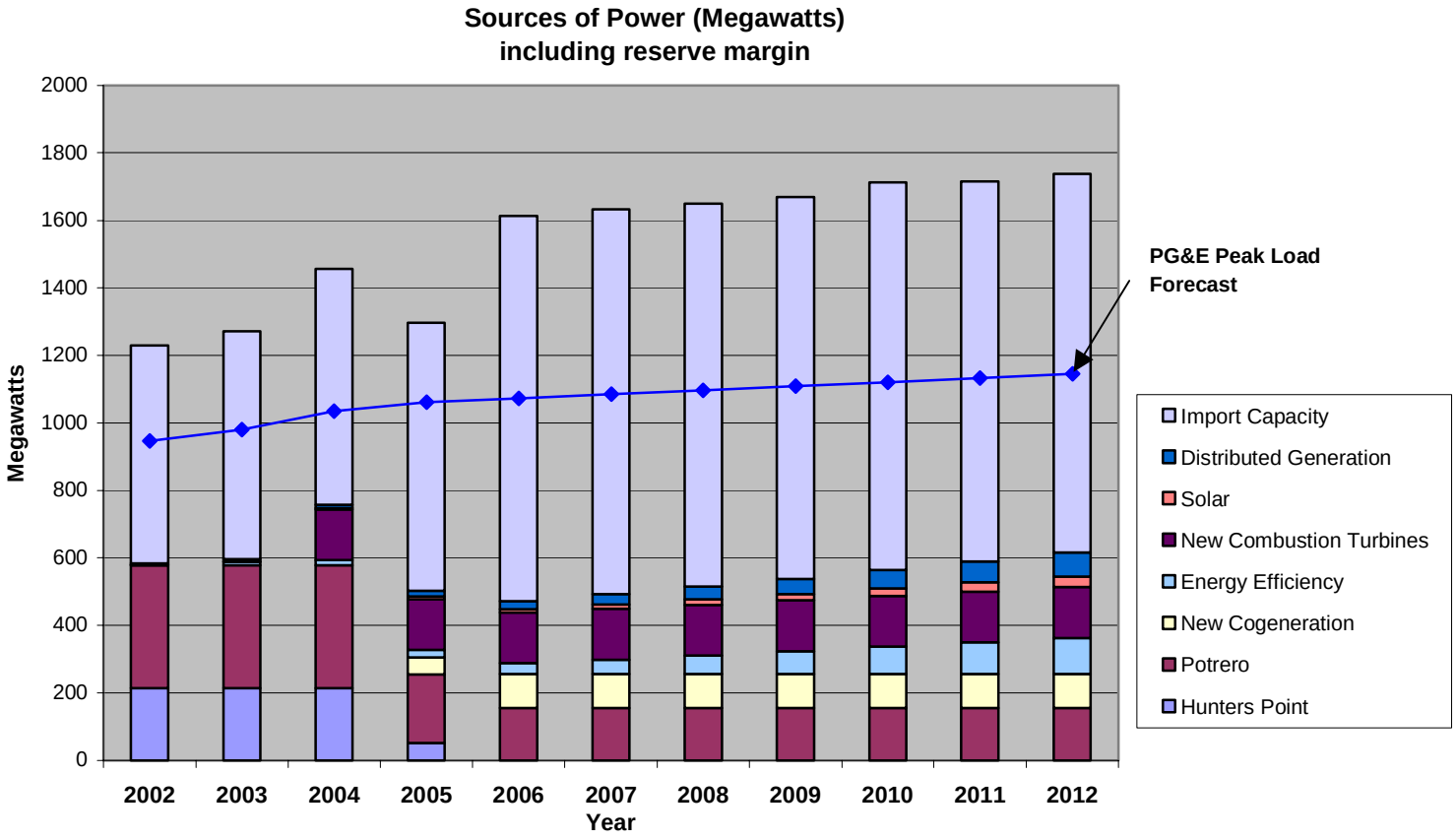


Figure ES2. The graph above shows the projected resource mix for San Francisco, following the recommended electricity resource portfolio described in this Plan.

Recommendations to Support an Action Plan

Based on months of research, independent analysis, and public input, the SFPUC and SFE are recommending a strategy to shut down the Hunters Point power plant and Potrero Unit 3 and to set the City on a sustainable course that shows a progressive decline in dependence on fossil fuels. In order to meet the City's electric reliability requirements, implementation of the Plan should begin immediately.

The main components of the Plan include:

I. A Clean, Reliable Electricity Portfolio

Demand Reduction through energy efficiency and load management. This is generally a cost-effective means of reducing electricity load. The objectives are: 16 MW by 2004; 55 MW by 2008; 107 MW by 2012.

In San Francisco, demand reduction needs to be accomplished citywide. Since commercial users make a substantial contribution to peak demand they need to be targeted for peak reductions, with special focus on downtown buildings. The California Independent System Operator (ISO) gives priority to meeting the downtown network load in the event of a multiple transmission failures while allowing other areas to be blacked out on a controlled basis; therefore, every megawatt reduction in the downtown network makes in-city generation available to other areas in San Francisco and lessens the likelihood of blackouts.

City-owned facilities will likewise be targeted for load reduction and will be managed by SFPUC. The Department of Environment oversees several efficiency programs for the private sector. These programs will have to be augmented to include incentives, changes in codes and standards, outreach, and training to achieve the goals of the Plan.

Renewables. Programs to harness the sun, wind, water, and other natural sources will be a high priority. The objectives for renewables are: 7 MW by 2004; 28 MW by 2008; 50 MW by 2012.

Solar power is an excellent distributed resource because of its modularity. It can be sized all the way from multi-megawatt systems down to hundreds of watts on residential roofs. The SFPUC will soon begin the City's first large solar power development at the Moscone Center. This football-field sized showpiece will produce about 688 kilowatts. A second 600-kilowatt solar site is planned for the Southeast wastewater treatment plant. Other proposed municipal sites include the airport and the port. SFE will undertake an aggressive program to identify and develop sites in the private sector.

There are wind technologies appropriate for urban applications, though the most significant amounts of wind power are outside the City in areas such as the Altamont Pass, where wind speeds and proximity to transmission can be met. Hetch Hetchy can build wind turbines at Altamont and at sites along its transmission right-of-ways.

Tidal current and wave generation are in a pre-commercial development stage. The theoretical potential for these resources in the Bay Area is in the hundreds of megawatts of power. The City should seek partnerships with the federal and state governments in exploring the potential of these resources and take the lead in providing the opportunity for demonstration sites.

Medium-sized Generation and Cogeneration. Mid-size plants of about 50 megawatts can provide high levels of reliability and could be built in several locations in San Francisco. This Plan assumes the megawatts needed to help shut down Hunters Point and Potrero Unit 3 are: 150 MW by 2004; 250 MW by 2008.

These plants will be the most efficient gas-fired generators available and will be used as replacement generation for the old, polluting plants in the City. The quantity of new natural gas-fired generation should be based on a publicly reviewed reliability analysis. Whenever investment in demand-side management and sustainable resources can offset new fossil fuel development, this will be the City's preferred course.

Cogeneration is the production and use of electricity and heat from a single installation. It is favored because the total efficiency goes up when the heat created from combustion is captured and used. One site currently under consideration is a 50-megawatt cogeneration plant at 5th and Jessie Streets in the City. The present facility burns natural gas to boil water into steam. This installation could produce steam to feed into the existing district heating system, with 50 MW of electricity being generated as a by-product of the steam production. Another possible site for a cogeneration system is the Mission Bay campus of the University of California, San Francisco where the potential for district heating is substantial.

Small-scale Distributed Generation (DG). These include fuel cells, packaged co-generation, and micro-turbines. DG generators range from 10 kilowatt to 5 megawatts in size and usually support single facilities. The objectives are: 10 MW by 2004; 38 MW by 2008; 72 MW by 2012.

The SFPUC will identify sites for municipal applications and the SFE will work with downtown building owners and other businesses to find appropriate sites and to facilitate installation.

The effective deployment of distributed generation will require the cooperation of PG&E for interconnection to the grid, and the assistance of City departments in streamlining permitting.

Transmission. An upgrade to an existing line and a new transmission line scheduled to be built on the Peninsula to service San Francisco will be necessary for long-term reliability, and should be supported by the City. At the same time the City should commit to securing a continually increasing percentage of renewable sources to feed into the transmission grid.

II. Environmental Justice

SFE will take responsibility for seeing that communities in Southeast San Francisco will benefit from the programs developed through this Plan.

Air quality will be more effectively monitored as a measure of the success of the Plan. The department will also monitor and periodically report on bills for low-income residents and the dispersion of energy program benefits, including training, employment, and business development.

III. Implementation and Review

Implementation of the Plan needs to begin immediately to accomplish the 2004-2005 objectives. Relevant activities have already been initiated and can be expanded, as funding is available. Successful implementation of the Plan will require strong continued participation by the public and support from City officials.

SFE and SFPUC will work with each sector of the San Francisco economy to promote efficiency, renewable energy and distributed technology for their facilities and to develop specific objectives and timelines.

The Plan will be evaluated and updated to reflect new developments and SFE and SFPUC will submit an annual report to the Board of Supervisors on achievements and challenges of the energy program.

Introduction

The City of San Francisco is at a crossroads on energy policy as it faces decisions on how electricity will be produced, delivered and used in the near term and over the next twenty to thirty years. The City's economic and environmental health is vulnerable to a number of risks that could become critical if initiatives are not taken to address them. An important step in that direction is the "Human Health and Environmental Protections for New Electric Generation" ordinance passed unanimously in May 2001 by the Board of Supervisors. The ordinance directed the San Francisco Public Utilities Commission (PUC) and the Department of the Environment (SFE) to develop plans to implement all practical transmission, conservation, efficiency, and renewable alternatives to fossil fuel generation in the City.

The ordinance was initiated by Supervisor Sophie Maxwell in response to community concerns over the proposed construction of a large (540 megawatt) new power plant at the Mirant facility in the southeast sector of the City, which she represents. The neighboring communities have already been suffering an unfair burden of the price of modern-day society's dependence on electricity. Mirant's facility currently has one 207-megawatt plant (Unit 3) and three 52-megawatt "peakers" for use during times of peak demand. The only other power plant in San Francisco is nearby at Hunters Point, where PG&E operates one 163-megawatt plant (Unit 4) and one peaker. These plants are old, inefficient, prone to failure, and extremely polluting. People living in these neighborhoods experience an exceptionally high incidence of respiratory ailments, especially children and the elderly.

Central to the debate over the proposed plant, aside from its size, is whether or not it will allow the state's Independent Systems Operator (ISO) to close the Hunters Point plant. In 1998, Mayor Brown and PG&E agreed that the plant would be shut down as soon as replacement power became available, a condition imposed by the ISO. Because the City is located at the end of a peninsula, there is limited ability to import electricity into San Francisco to replace power from Hunters Point. During periods of peak demand, the City can import over existing transmission lines only about 60 percent of the power it needs. Therefore, San Francisco is dependent on power plants within the city, and Hunters Point units have continued to help fulfill that need.

Developing An Alternative Plan

In exploring alternatives that would reduce fossil fuel emissions in southeast San Francisco, as directed by the ordinance, the SFPUC and SFE continued to view the shutdown of Hunters Point as the central issue. The recommendations presented in this Plan are based on findings determined after a year of research and evaluation of San Francisco's electric resources, potential demand reduction through energy efficiency and peak electricity load control, prospects for renewable resources, and opportunities for

new, clean energy technologies. Nine public meetings were held to share information, define goals, and set priorities.

The staff has made every effort to capture and incorporate public input. Comments from public meetings and written comments submitted to the SFPUC or SFE are available on SFE's website, www.sfenvironment.org. Because the public review period was replete with developments in the electricity market that directly affected San Francisco, the discussions at public meetings often extended beyond the scope of the ordinance, but have been considered in the goals, analysis and recommendations of this Plan. The recommendations recognize the necessity of making the Plan flexible and keeping it updated to reflect the changing climate.

1 Setting Goals

This Plan is not the first to address San Francisco's energy choices and the serious health and environmental risks associated with energy production and use. In 1981, the Bureau of Energy Conservation was created under the SFPUC to provide energy efficiency services for City facilities. The following year, the San Francisco Planning Commission adopted the *Energy Policy* component of the Environmental Protection Element of the City's General Plan. That policy specifies means to attain energy efficiency, as well as the promotion of renewable energy and transportation strategies. The major goals expressed in the *Energy Policy* are: more efficient use of energy, balance of energy supplies to meet local needs, economic development, and responsible community participation. The Bureau of Energy Conservation became the principal implementer and over the years managed efficiency projects in City office buildings, MUNI facilities, schools, and other municipal properties.

In 1996, the Department of the Environment was created and an assessment of the *Environmental State of the City* was undertaken. The study led to the adoption of the City's *Sustainability Plan* by the Board of Supervisors in 1997. That plan included a broad scope of environmental issues such as air quality, human health, biodiversity and solid waste management under the rubric of promoting sustainability. The major energy goals expressed in the plan are: reduction of overall power use through maximizing energy efficiency; maintaining an energy supply based on renewable, environmentally sound resources; elimination of climate-changing and ozone-depleting emissions and toxics associated with energy production and use; and basing energy decisions on the goal of creating a sustainable society.

Among the important steps taken by the City following the adoption of the *Sustainability Plan* was to enter into an agreement with PG&E in 1998 to close the Hunters Point power plant. Pollution from the 44-year-old plant has been a contentious issue for communities in Southeast San Francisco, where respiratory disease is disproportionately high. Since that agreement was signed, two of the plant's four units have been shut down. The other two operate on an as-needed basis, or "reliability must run" status. The plant cannot be closed until regulatory authorities determine that enough replacement power is available to meet the City's electricity demand.

The fulfillment of the four-year old agreement to close the Hunters Point power plant is central to the implementation of this *Electricity Resource Plan.* In January 2005, new clean air standards may require the plant to undergo a major air emissions overhaul. Such an expensive investment would only justify extending its operation. Thus, a principal driving force for this Plan and its first major milestone is to develop and deploy, before 2005, sufficient electricity replacement from the most environmentally sound sources to convince the regulatory agencies to permanently close the plant. At the same time, the City will pursue a strategy for the downgrading and eventual retirement of the other aging fossil fuel unit at the Potrero power plant, also located in the southeast sector.

The Plan sets a second milestone for 2012 that coincides with the Mayor's public commitment to reduce greenhouse gases to 20 percent below 1990 levels. The closure of polluting plants and expanded efforts in efficiency, renewables, and clean technology combustion generators will help to meet that target. For the longer term, the Plan calls for a renewed commitment and an accelerated pace to achieve the goals of the 1997 *Sustainability Plan*--the elimination of all fossil-fuel power, an energy supply based on renewable, environmentally sound resources, and maximum energy efficiency.

Public Process

The City Ordinance introduced by Supervisor Sophie Maxwell directing the SFPUC and the Department of the Environment to prepare this Plan called for a period of public review and comment. Between November 2001 and August 2002, the departments jointly hosted two rounds of neighborhood meetings to solicit input for the Plan, and participated in public forums on energy policy with energy experts, planners, and business and community leaders. At the first round of district meetings, the purpose was to identify goals to guide the development of the Plan. SFPUC and Department of the Environment staff described how the City currently gets its energy and the potential vulnerabilities the City faces. They presented information on electricity demand, generation, transmission, energy efficiency and renewable technologies, and facilitated discussion on goals. In addition to these hearings, Supervisor Jake McGoldrick held a town hall meeting at which goals for an electricity plan were discussed and ranked.

With this information, and the technical assistance of Rocky Mountain Institute, an independent consultant, the staff developed and distributed a draft *Electricity Resource Plan* and scheduled another round of public hearings. The draft plan described three scenarios to illustrate salient issues and possible options for addressing them. The scenarios were used at public meetings to generate discussion and ideas for a specific approach to electricity policy, with the previously identified goals as guidance.

The Significance of Recent Developments

In the period since the ordinance was passed over a year ago, developments in the energy industry and in the political arena have created new concerns for San Franciscans. Perhaps the most significant event was the collapse of Enron, one of the key players in California's energy market. The shockwaves that spread throughout the industry had financial and legal repercussions for a number of energy producers in the state, including Mirant, the owner of the Potrero plant. Regulatory hearings on Mirant's controversial proposal to build a large, new fossil-fuel plant at its Potrero site are moving slowly as a result of design and environmental issues, but even if a license were eventually granted, the plant would not come on line in time to provide the replacement power needed to shut down Hunters Point. Another project that could help retire Hunters Point, a new transmission line from the Peninsula into San Francisco, will also be too late even under the most optimistic projections.

There were also energy-related developments in City government since the Plan was initiated: the passage in 2001 of two bond measures to finance renewable energy and efficiency projects; public power initiatives on the 2001 and 2002 ballots that although unsuccessful, had widespread support; and the Mayor's announcement of a greenhouse gas reduction goal for 2012. Following the September 11 attacks, concern for security raised awareness of the vulnerability of large generation and transmission structures and interest in more dispersed energy sources. This period also saw no resolution to the PG&E bankruptcy and no indication that a stable electricity market would soon emerge in the wake of the state's failed deregulation experiment.

Since the outset of the public review process, these and other ongoing events raised questions that broadened the scope of discussions at meetings about the Plan. There were expressions of the need for a more comprehensive approach to energy policy, including: consideration of natural gas as well as electricity supply and use; environmental impacts beyond San Francisco; and the effect on price and reliability should the City gain control over electricity service. Because all these issues have a bearing on the prospects for successfully reducing the health and environmental justice impacts in Southeast San Francisco as called for in the ordinance, they have been considered in the analysis by SFPUC and SFE and are reflected in the recommendations described in Chapter 6.

Goals Defined

Based on comments received during the public hearing process, eight goals were selected to guide the Plan. As noted above, the goals expanded on the specific scope of the City Ordinance due to new public concerns over developments directly related to San Francisco's energy future. The broader goals tend to lend even stronger support for a plan that seeks solutions to the health and environmental impacts in Southeast San Francisco. The goals are:

- Maximize Energy Efficiency
- Develop Renewable Power
- Assure Reliable Power
- Support Affordable Electric Bills
- Improve Air Quality and Prevent Other Environmental Impacts
- Support Environmental Justice
- Promote Opportunities for Economic Development
- Increase Local Control over Energy Resources

Maximize Energy Efficiency

Energy efficiency reduces the amount of electricity used by homes and businesses, consequently lowering energy bills, peak demand, and the need for more and bigger power plants. Efficiency can be achieved through installing more efficient appliances and equipment (e.g. lighting, refrigeration, motors, computers) and designing more energy efficient buildings by using daylighting techniques, insulation, double-paned windows, etc. Conservation (turning off appliances and equipment when not in use) and energy management practices and controls that govern when electricity is used also help reduce peak demand and energy bills. Factors determining investments in efficiency projects include the cost to save a kilowatt-hour versus cost to buy or generate a kilowatt-hour, confidence in the persistence of energy savings over time, and willingness to make long- term investments. When lifecycle costs are considered, specific efficiency measures have been shown to have higher returns on investment than construction of new power plants.

The public expressed a desire for more aggressive efficiency programs. Many energy efficiency technologies are mature, available and cost effective. Money saved as a result of reduced energy consumption can be retained in the community and spent in the local economy to create jobs. Building codes and appliance standards also influence energy efficiency. Energy efficiency programs for City buildings are managed by the SFPUC. The Department of the Environment manages several programs for commercial and residential buildings, but most available funding for the private sector is administered by PG&E or the California Public Utilities Commission (CPUC).

The City was urged to facilitate Propositions B and H (see below), which include energy efficiency as well as renewables. Energy efficiency also satisfies multiple other goals: reliability, affordable bills, no pollution, local control, and economic development.

Develop Renewable Power

Electricity can be produced by renewable sources with technologies that capture energy flowing through the earth's natural systems. The sun, the wind, the flow of water, tides and waves, the earth's internal heat, and biomass all can be used to produce electricity. Renewable power is distinguished from fossil fuels and nuclear power, which are finite and depletable. While renewable electricity can have environmental impacts, they are generally less damaging than the combustion of fossil fuels or nuclear irradiation.

In the November, 2001 election, San Franciscans voted overwhelmingly for Proposition B, which authorized $100 million in bonds to finance renewable and efficiency projects in City-owned facilities. Proposition H was also passed, which gives the Board of Supervisors the power to issue revenue bonds for renewable and efficiency projects in the private sector as well. The pace at which renewable energy can be developed will be influenced by several factors including cost, financing mechanism, availability of sites and materials, and interconnection with current utility lines.

The public comments reflected the strong support for renewable energy that had been expressed in the election, and the need to facilitate timely funding from Propositions B and H. There was a call for the City to act immediately to pursue renewable resources aggressively, beginning with proven technologies, such as solar panels and wind turbines. At the same time the City should be on the forefront of acquiring newer technologies such as fuel cells, and considering the options for tidal energy. Renewable energy will help attain the goals of reliability, affordable bills, reduced pollution, local control, and opportunities for economic development.

Assure Reliable Power

Reliability of a power system depends on the combination of resources that are available at all instants in time to meet the demand for electricity. Reliability can be improved through building redundancy in the generation and transmission resources. It can also be improved through electricity load management and through peak demand reduction from energy efficiency programs.

Most power outages are a result of problems on the distribution system. They are local in nature and usually affect a small percentage of customers. However, if sufficient electricity resources are not available in a region, then widespread "rolling blackouts" can occur. To lessen the probability of rolling blackouts, electric systems are designed to have a "reserve margin" of electricity generating resources. San Francisco, because of its location at the end of a peninsula, requires more redundancy of power supplies than areas that are served by transmission lines emanating from several directions. San Francisco's reserve margin is now provided by the Hunters Point and Potrero power plants.

It is important that future electricity demand forecasts be accurate and regularly updated. While it is necessary that adequate supply is available, overbuilding of resources to assure reliability can be costly. Not only are financial resources used inefficiently when too much capacity is built but limited land and water resources are diverted from other potential beneficial uses. These points were expressed emphatically at several public meetings. Reliability came to be closely linked with the need for more local control, small-scale generation, renewables, and energy efficiency.

Support Affordable Electric Bills

There are two ways to reduce electric bills--by lowering the rate charged per kilowatt-hour or by lowering the amount of electricity used. The electric rates charged by the utilities are set by the California Public Utilities Commission (CPUC). The CPUC imposed a surcharge on PG&E's rates in response to the historically high prices charged by producers in 2000 and 2001. The length of time that the surcharge will remain in place is uncertain. The cost of new generation technologies, transmission and distribution, and the cost of fuel will determine future electric rates.

This goal also addresses volatility of prices and equity in setting rates among different customer classes (residential, commercial, etc.). Currently these questions depend on the

future regulatory and electricity market structure for California. If the State decides to rely on competitive pricing, San Francisco's rates will be most impacted by the degree to which generators can exercise market power.

There was public concern over the concentration of power plant ownership in the City. This issue supported arguments for more local control and smaller scale generation, especially renewables. To keep bills low, the City was urged to create opportunities for all classes of customers to participate in energy efficiency and peak reduction incentive programs.

Improve Air Quality and Prevent Other Environmental Impacts

Generating electricity can have a significant impact on air quality. The emissions from all large power plants are regulated by the Bay Area Air Quality Management District (BAAQMD). BAAQMD administers the federal Clean Air Act, including monitoring the emission of "criteria" pollutants such as nitrogen oxides and particulate matter from power plants, and overseeing the trading of "offsets" between emitters of these pollutants.

Citizens expressed a strong desire to reduce air pollution associated with energy production in San Francisco. A high priority objective is to shut down the Hunters Point plant. BAAQMD requires that if any new generation source that creates pollution is built to replace Hunters Point, there must be offsets in pollution identified over the entire Bay Area airshed. However, participants in public hearings wanted guarantees to reduce emissions at the source, near the communities most impacted. In addition to reducing regulated pollutants, San Franciscans want to reduce their share of global warming impacts. Power plants emit CO_2, which is a significant contributor to climate change.[2] There was great concern that San Francisco does not export health risks elsewhere nor create environmental impacts on the ecosystem of the Bay and other sensitive areas.

Key factors that will determine future air quality impacts include the schedule of the Hunters Point shutdown, the retrofit or shutdown of Potrero Unit 3 and the retrofit or replacement of peaking generation at that site.[3] Individuals and citizens' groups expressed grave concern over the construction of a new large plant at Potrero and supported aggressive energy efficiency programs and the installation of renewables and small cogeneration plants as an alternative.

[2] The Department of Environment is developing a Local Climate Action Plan to reduce San Francisco's greenhouse gas emissions. The Plan will include recommendations for actions in the areas of energy, transportation, and solid waste.

[3] The May 2001 City ordinance addresses these issues in relation to the proposed siting of new generation at Potrero, Op. cit. 1.

Support Environmental Justice

The neighborhoods of Southeast San Francisco have historically borne a disproportionate burden of environmental impacts. The neighborhoods predominantly consist of low-income, non-white residents, many of whom have developed ailments related to these environmental impacts. Sources of such impacts, such as air emissions, include the Hunters Point and Potrero power plants. The major concern people have expressed is public health, especially that of children. Children in Southeast San Francisco have higher rates of asthma than in other parts of the City. While these communities bear the negative environmental and health costs of these plants, they do not have access to the financial benefits that accrue to the owners of the plants or to the businesses outside their neighborhoods whose success is so reliant on electricity.

This goal seeks to minimize environmental impacts in Southeast San Francisco, to make sure that any impacts are distributed more equitably throughout the City, and to mitigate for past and present injustice by focusing the benefits of health and clean energy programs in the Southeast.

Factors influencing Environmental Justice overlap with those discussed above under Improved Air Quality. As voiced at public hearings, the most pressing issue is the closure of old polluting power plants and the prevention of the construction of any new polluting sources of electricity generation in the Southeast. More renewable sources and the expansion of energy efficiency programs were proposed as alternatives.

Promote Opportunities for Economic Development

The choices San Francisco makes about its energy future will have a bearing on the local economy. Not only is it important that homes and businesses have reliable and affordable energy, but also that some of these businesses become part of the local energy supply infrastructure. This goal would consider to what extent different energy technologies are able to keep dollars in the local economy by supporting in-City manufacturing, production, distribution, and installation services.

Technologies that are largely external to the local economy include combustion and combined-cycle turbines, microturbines, fuel cells, and large wind turbines. With the exception of wind turbines, the fuel needed to run these systems also involves the outflow of dollars. Solar technologies, peak load management systems, and energy-efficient products are available locally and reduce spending on fuel.

The public saw new opportunities for the local economy in an increased demand for solar products and energy efficiency, especially with the passage of Propositions B and H. An expanded and growing market in San Francisco would support new business enterprises and create jobs while helping to reduce pollution.

Increase Local Control over Energy Resources

Having control over our energy resources means that the City and citizens can influence which electricity generation facilities are built in San Francisco and which resources are imported to meet our needs. The prospect of a City-controlled electric utility has taken on new significance with the failure of deregulation and the volatility of the energy market. Two initiatives on the 2001 ballot that would have mandated the revocation of PG&E's electric distribution franchise in the City and moved to set up other institutions, were defeated; a similar initiative in 2002 also failed.

Where local control can be most effective is in the promotion and development of small electricity generators. Permitting of power plants under 50 MW in size is subject to local review under the California Environmental Quality Act (CEQA). The siting of these smaller power plants requires that a local agency assume the lead in determining what the environmental impacts of a proposed power plant are and providing for their mitigation. It is possible for the City to either own smaller power plants through the Hetch Hetchy Water and Power system or enter into contracts for the power. Very small generators, particularly renewable energy generators, are completely within the influence of the City.

Local control can help facilitate good energy management, including long-term planning, public education, and economic development that involve local labor and businesses. Whether or not the City assumes some role in the distribution of power, the public was definitely in support of exerting more effort where the City and citizens already have control, such as renewables, energy efficiency, and small-scale distributed generation.

2 Structure of the Electricity System

The current system of electricity production, transmission and distribution for San Francisco is the result of decades of decisions made by private utilities, state regulators, state and federal legislative bodies and the City of San Francisco (see figure 2.1). A review of the key developments can help explain the complex situation we face today in deciding our energy future.

PG&E and San Francisco's Electricity System

No organization has had a greater impact on the design of San Francisco's electric system than has the Pacific Gas and Electric Company (PG&E). PG&E was formed in 1905 to harness the hydroelectric potential of rivers in the Sierra Nevada like the Feather, the Mokelumne, and the Pit. The state granted monopoly status to PG&E as a supplier of electricity in Northern California by the 1930s. By the 1950s, the basic architecture of the high voltage transmission system bringing power into the Bay Area was formed. San Francisco, being at the tip of a peninsula, gets most of its electricity over power lines swooping across the Central Valley and then winding their way around and across the South Bay.

PG&E, like other investor-owned utilities in the United States, thrived for decades under a system of state regulation. A stable legal and economic structure allowed electric utilities to earn a predictable return on their investments in exchange for providing universal service with regulated rates. Under this regulatory structure PG&E was able to build major fossil fuel power plants in Pittsburg and Moss Landing in the 1950s and 1960s to serve the Bay Area. In San Francisco, PG&E built smaller plants at Hunters Point in 1958 and Potrero in 1965 to provide reliable service at the end of its transmission lines.

In the late 1960s PG&E, like many other utilities, including Southern California Edison, made a commitment to develop nuclear power. Both California utilities faced formidable challenges during construction that caused significant delays and cost escalation. At the beginning of the 1980s slippage in the construction schedules at Diablo Canyon and San Onofre triggered concerns about possible shortages of power in California. Because of these concerns the California Public Utilities Commission (CPUC) aggressively promoted non-utility development and ownership of power plants.

Taking advantage of a 1978 federal law, the Public Utility Regulatory Policy Act (PURPA), California led the nation in encouraging the development of geothermal, biomass, wind, and solar thermal generating capacity. By the early 1990s about 11 percent of California's electricity came from non-hydro renewable energy sources. In addition to incubating the development of renewable energy technologies in California, PURPA also stimulated the mainstreaming of cogeneration power plants that very efficiently use fuel to produce both heat and power.

At the same time, the CPUC ordered PG&E to institute demand-side management (DSM) programs, which encouraged the implementation of energy-efficiency measures as a means of meeting new demand for power. PG&E's DSM efforts enabled the utility to cost-effectively defer investments in new power plants and brought nation-wide recognition of the role of electric utilities in managing energy-efficiency programs.

In 1994 the CPUC announced that it wanted to end the monopoly power of the state's investor-owned utilities, eliminate government supervision of electric resource planning and give consumers a choice of electricity suppliers. By 1996 the California legislature unanimously passed legislation designed to accomplish these goals. Under orders from the legislation, PG&E sold off most of its fossil fuel and geothermal power plants to private companies not regulated by the state. Its transmission lines were placed under the control of a new non-profit organization called the Independent System Operator (ISO) that was given responsibility for assuring that all power plants would have non-discriminatory access to the grid and thus to customers. A separate organization called the Power Exchange ran short-term spot markets that set the price for power that PG&E and the other electric utilities bought.

PG&E still had the responsibility of running the local distribution system and procuring power from the wholesale market for customers who did not choose an alternate provider. Rates PG&E could charge those default customers were still regulated by the CPUC. By early 2001 this "deregulated" system collapsed. In December 2000 wholesale prices in the spot electricity market doubled, then quintupled and then went up by more than ten fold; however, PG&E was not allowed to raise rates. By early April 2001, PG&E had filed for bankruptcy, the Power Exchange went out of business, and the State of California became the power buyer of last resort.

In San Francisco, PG&E sold its power plants at Potrero in 1999 to the Southern Company, a large Atlanta based electric utility. In 2001 the Southern Company spun off its unregulated power plants into a newly formed publicly traded corporation called Mirant. PG&E retained the power plants located at Hunters Point. In July 1998 PG&E entered into an agreement with the City to close the Hunters Point plants when they are no longer needed for electric reliability in San Francisco. Two of the four power plants were closed in July 2000 and converted to synchronous condensers[4] to maintain the appropriate voltage necessary to support the grid. The remaining power plants operate only when ordered to do so by the ISO. The ISO is ultimately responsible for determining when the plants can be closed.

To ensure that utility-managed energy-efficiency programs would not fall by the wayside, a Public Goods Charge (PGC) was added to customers' electric bills to fund the continuation of energy-efficiency and renewable programs.

[4] A synchronous condenser is a motor that is operated to provide stability to the grid. It does not directly produce air pollutants.

Since 1997, PG&E and the other California investor-owned utilities have been collecting the Public Goods Charge and using these funds to administer energy-efficiency programs under the direction of the CPUC

Energy Agencies and Their Responsibilities

Entity	Jurisdiction
Independent System Operator (ISO)	Operates the transmission system. Sets reliability criteria, issues RMR contracts, approves transmission projects
California Energy Commission (CEC)	Issues power plant licenses, sets energy efficiency standards
California Public Utilities Commission (CPUC)	Regulates distribution system. Sets electric rates, approves rate basing of transmission and efficiency projects
Bay Area Air Quality Management District (BAAQMD)	Enforces Clean Air Act emissions standards, issues permits, regulates emissions trading
Federal Energy Regulatory Commission (FERC)	Sets electric rate caps, regulates ISO
California Power Authority	Provides financing for various renewable, reliability, and efficiency projects
Governor	Appoints ISO, CEC, CPUC board members
State Legislature	Enacts energy legislation (e.g. 1996 deregulation bill - AB 1890, 2002 aggregation bill- AB117)
Pacific Gas and Electric Company (PG&E)	Owns/operates Hunters Point power plant. Owns/operates electric distribution system in SF, owns most of the transmission system in Northern California. Administers most PGC funds
Mirant	Owns/operates Potrero power plant

Figure 2.1

City Government and the Hetch Hetchy Project

The City of San Francisco also provides a sizeable amount of electricity to the Bay Area through the Hetch Hetchy Water and Power project. The City first began generating power in 1921 at a power plant developed in compliance with the federal Raker Act. That Raker Act grants the City rights of way to federal lands in and next to Yosemite National Park for the purpose of developing water and power facilities including the construction of O'Shaugnessy Dam at Hetch Hetchy.

Currently, the City operates three powerhouses – Mocassin, Holm and Kirkwood. These powerhouses contain seven turbines capable of producing 401 megawatts of electricity during the Spring run-off when the reservoirs behind the powerhouses are full. During a year with average rainfall the Hetch Hetchy project is capable of producing 1.7 billion kilowatt-hours of electricity In addition to the power production facilities, the City owns approximately 150 miles of high voltage transmission lines that link the power plants with the California electric grid at Newark (see figure 2.2). While this quantity of power exceeds San Francisco's municipal power demands on an annual basis, the City needs to supplement its power sources to meet municipal demand and its contractual obligations during the summer and fall months when power generation is reduced so that water can be stored.

The Raker Act requires that any power that is surplus to the City's municipal needs be made available at cost to the Modesto and Turlock Irrigation Districts to meet their municipal needs. Any power that is excess to both the municipal needs of San Francisco and the Districts can be sold to public power agencies. In practice, most of this power was sold to Modesto and Turlock to meet residential and business load served by the Irrigation Districts. The Raker Act prohibits the sale of Hetch Hetchy-generated electricity to investor-owned utilities for resale. Therefore, the City cannot sell any surplus power to PG&E.

Prior to 1985 Hetch Hetchy sought to minimize its operational requirements and risks while still meeting the City's obligations under the Raker Act. Power production occurred principally as a by-product of reservoir releases to deliver water to the Bay Area. This mode of operation resulted in lots of electricity being generated from February into June and being offered to Modesto and Turlock at cost.

In the early 1980's, there was a growing awareness that energy resources were finite and that environmental protection was important. The City recognized the need for and value of energy-efficiency. In 1981, The Bureau of Energy Conservation was created under the SFPUC to provide energy-efficiency services for City facilities, including lighting and HVAC retrofit projects as well as design review for new capital improvement projects. Energy saved in City facilities could be sold at a higher rate thus yielding revenue for the City's general fund and reducing operations and maintenance costs to City departments. In 1982, the *Energy Policy* of the City's General Plan was adopted. It identified energy-efficiency in both the public and private sectors as a priority.

Negotiations with PG&E and the Modesto and Turlock Irrigation Districts resulted in new contracts for the delivery of power to the Districts. The City agreed to buy power from PG&E to firm 260 megawatts of Hetchy's generation capacity and the Districts agreed to purchase all firm power not needed by the City to supply its own facilities. Power purchased by the Districts under this new agreement was set at rates that were designed to produce a modest profit for San Francisco. Until 2001 this arrangement produced surplus revenues that had been transferred to the City's general fund. Over the ten years prior to 2001 the transfer averaged $34 million annually.

In 1998 with the restructuring and partial deregulation of the electricity industry in California, the City began to buy all of the power needed to firm up its delivery requirements from the short term "spot" energy market. Until the summer of 2000 prices in the spot market were lower than what the City had previously paid PG&E. But by December 2000 the wholesale power market became completely dysfunctional. In the budget year 2000/2001 the City ended up paying $154 per megawatt hour for electricity, nearly fives times as much as it had paid in 1999/2000.

To lock in a price for power that was needed to firm up San Francisco's obligations for serving its own municipal load and to meet the Irrigation District's contractual requirement, the City entered into a five-year power purchase contract with Calpine.

Electricity Markets and the Regulatory Landscape

The move to deregulate the electricity industry in California set electricity markets and the regulatory structure in a new direction that remains unpredictable today. In 1995, the California Public Utilities Commission (CPUC) issued a decision designed, among other things, to provide customer choice, competition over traditional monopoly services, and a reduction in electricity prices for consumers. The decision created the California Independent System Operator (ISO) and the Power Exchange (PX), ordered utilities to divest fifty percent of their fossil generation, and established a competitive transition charge (CTC) assessed on all utility retail customers during a five-year transition period. Additionally, utilities were obligated to sell their generation into the PX and then purchase to meet customer needs from the PX. In 1996, Assembly Bill (AB) 1890 was passed, providing a legislative foundation for electricity restructuring in California.

During this same period, the Federal Energy Regulatory Commission (FERC) was moving towards opening up the bulk transmission system FERC Order 888 encouraged the formation of independent system operators (ISO) for regional transmission systems and allowed owners of power plants to price wholesale electricity based on market prices rather than on regulated rates.

In effect, AB 1890 and Order 888 provide for an electric transmission system in California that is now regulated by FERC while the utility's distribution system remains under the jurisdiction of the CPUC.

Serious flaws in the new structure led to an unprecedented rise in wholesale electricity prices beginning in 2000. Although price caps existed, they were ineffective because of the threat of blackouts. Despite orders from the federal government to sell electricity into California, many power producers withheld generation and forced the involuntary curtailment of electricity. Meanwhile, California's Investor Owned Utilities (IOU) were incurring increasing debt because the retail rate freeze under AB1890 did not allow IOUs to recover all the costs incurred for power purchases, leading Pacific Gas & Electric Company to declare bankruptcy.

Governor Gray Davis declared a state of emergency and authorized the California Department of Water Resources (DWR) to purchase power for customers of California's three major electric utilities. At first, DWR purchased power in the day-ahead markets at exorbitant prices. Subsequently, it was able to enter into a series of longer term contracts at significantly lower prices but still substantially above the cost of producing electricity.

As part of its remedy to fix California's dysfunctional market, FERC revoked the utilities' requirement to buy all power through the spot market in December 2000, leading to the demise of the PX and the ability of IOUs to trade in an open market. In addition, FERC established a new wholesale price cap. These actions, the DWR contracts, the completion of several new generation facilities, combined with aggressive electricity conservation by consumers, brought a degree of stability to wholesale electricity markets in California. However, very fundamental policy questions about how California will plan for, procure and price electricity in the future have not been answered.

How Will Proposed Changes Affect San Francisco?

The ISO has filed a comprehensive market redesign of the wholesale electricity markets at FERC. Two components of the re-design are crucial for San Francisco. First, the ISO is proposing a new method of pricing transmission based on congestion, which has the potential to raise wholesale electricity rates for San Francisco. On the other hand, this method would also make it more financially attractive for the development of new power generation in the City.

The ISO is also proposing local market power mitigation of energy bids in real time markets in order to prevent generators who are situated in transmission-constrained local areas from exercising market power. The computer-run bid adjustment would replace the current approach to mitigating market power. Currently, in San Francisco, designated power plants need to operate to provide local area reliability and their owners could demand prices far in excess of their costs. To mitigate the exercise of local market power that these units possess, the ISO has entered into Reliability Must Run (RMR) contracts with certain generation owners.

In July, 2002 the FERC issued an order on the ISO's market design proposal. In particular, FERC has extended the must-offer requirement with an increased price cap of $250/MWh from the existing level of less than $100/MWh. In addition, FERC authorized certain market design changes to be expedited and effective as early as January 1, 2003, including a new transmission congestion pricing model. The immediate addition of transmission infrastructure improvements to the San Francisco Bay Area is critical for protecting San Francisco ratepayers from price increases associated with this new congestion pricing method.

While the California ISO is refining its wholesale market re-design proposal, its long-term future is uncertain. The FERC is pushing for the formation of multi-state regional transmission organizations (RTO) that will enable the more efficient functioning of larger wholesale markets. The benefits to San Francisco of an RTO would be minimal since its

ability to import power is limited by available transmission lines. FERC also recently issued an order finding that the current ISO Board appointed by Governor Davis is not sufficiently independent and directed the ISO to adopt a two-tier form of governance by January 1, 2003. The top tier will be comprised of an independent, non-stakeholder Board with decision-making authority, and the lower tier will be comprised of an advisory committee of stakeholders. The state is contesting this governance change.

Potential market changes affecting San Francisco must also be evaluated within the context of the FERC's recent proposal to standardize the structure and operation of competitive wholesale power markets to prevent undue discrimination and market dysfunction.

Figure 2.2

Source: San Francisco Public Utilities Commission

3 Electricity Supply and Demand in San Francisco

San Francisco's electricity needs can be described as *electricity use* over time (measured in kilowatt-hours or megawatt-hours) or as *demand* (measured in kilowatts or megawatts). *Peak demand* is the highest total demand point reached in a given year. As shown below, San Francisco uses about 5,000 gigawatt-hours (GWh) (or 5 billion kilowatt-hours) of electricity per year and reaches a peak demand of about 900 megawatts (MW) in a given year. This Plan focuses on the quantity and quality of resources needed to meet San Francisco's peak demand for electricity over the next 2 to 10 years.

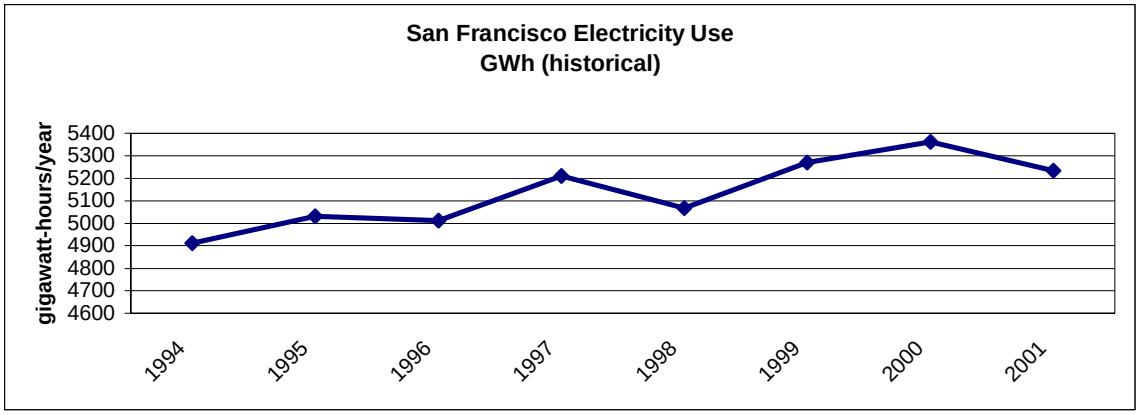
Electricity Use

In San Francisco more than 60 percent of electricity is used for commercial purposes while residential use accounts for 27 percent (see figure 3.1). From 1994 to 2000 consumption of electricity grew by 9 percent (see figure 3.2). Growth in consumption in both office buildings and residential buildings was slightly greater than in remaining uses. Overall electricity use decreased by about 2.4% in 2001.

San Francisco Electricity Use by Sector (Gigawatt hours)

Sector	1997	1998	1999	2000	2001	% of total*
Residential	1,323	1,363	1,439	1,431	1,421	27%
Offices	1,925	1,888	1,910	1,970	1,901	36%
Hotels	274	262	275	269	261	5%
Restaurants	207	208	213	216	221	4%
Retail Stores	209	192	229	219	218	4%
Food/Liquor Stores	164	171	174	170	181	3%
Hospitals/Health Care	152	142	150	151	151	3%
Misc.Commercial	143	142	149	165	165	3%
Communication	90	90	105	116	114	2%
Industrial	121	114	113	109	106	2%
Colleges/Schools	152	89	69	75	76	1%
Warehouses	60	55	58	58	55	1%
Streetlights	46	45	45	46	45	1%
Other/unclassified	345	308	342	368	321	6%
Total	**5,211**	**5,069**	**5,270**	**5,362**	**5,235**	**100%**

Figure 3.1
Source: California Energy Commission
* Based on 2001 use

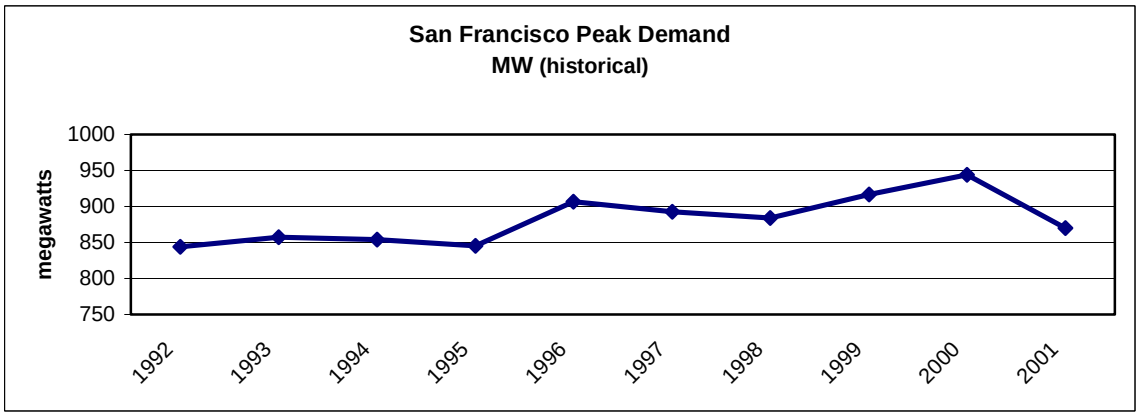


Year	1994	1995	1996	1997	1998	1999	2000	2001
Electricity Use	4,912	5,032	5,013	5,211	5,069	5,270	5,362	5,235

Figure 3.2 Source: California Energy Commission

Peak Demand

Forecasting peak demand is critical because there need to be sufficient resources available to meet electric load at times of peak demand and to withstand credible disruptions to transmission and/or power generation facilities. Summer peak demand happens in San Francisco during the hottest days, which can occur from mid-May through mid-October. A winter peak also occurs in December or January. Peak demand has been relatively stable over the past decade. It is important to keep in mind that demand side management (DSM) programs supported by public goods charge (PGC) funding were in place during these years and had a demonstrable effect on demand growth. Peak demand increased in 2000 by 3 percent and then declined in 2001 by 8.5 percent, dropping below 1997 levels. The increase in peak demand in 2000 can be partially explained by the robust economic growth in San Francisco across multiple sectors of the economy, including residential construction and activities associated with the Internet. The sharp economic downturn in 2001 occurred at the same time that a statewide campaign for energy conservation was being launched to avoid power outages. Figure 3.3 shows historical peak demand for electricity over the past 10 years.



Year	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Peak Demand	844	857	854	845	907	893	884	917	944	870

Figure 3.3 Source: PG&E

PG&E develops forecasts of future peak demand for the purpose of planning for grid reliability and for determining the need for additional transmission projects into San Francisco. These forecasts are published annually in PG&E's Electric Transmission Grid Expansion Plan.

For the purpose of the *Electricity Resource Plan*, we decided to use PG&E's two latest forecasts of load growth for San Francisco. (see figure 3.4 below) The ISO is currently using the higher forecast from PG&E's 2001 plan to evaluate transmission projects. This forecast projects that peak demand in San Francisco in 2002 to 2012 will grow from 946 to 1145 megawatts.

We chose to also consider the lower forecast presented in PG&E's draft 2002 plan with an adjustment up to account for a predicted "bounceback" from some amount of conservation achieved in 2001 assumed to be temporary. This adjusted 2002 forecast projects that peak demand in San Francisco in 2002 to 2012 will grow from 867 to 1077 megawatts. Both forecasts may be impacted by the pace of new developments expected to come on line in the next decade, such as Mission Bay, Hunters Point Shipyard, and Treasure Island.

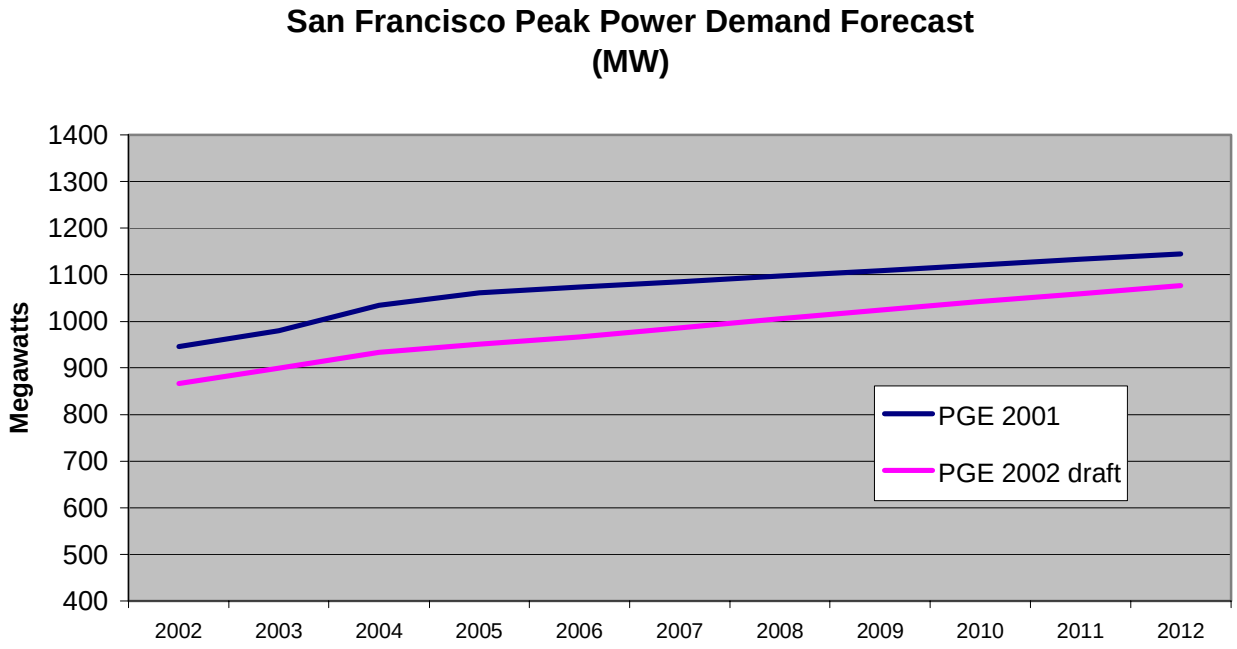


Figure 3.4

Source: 2001 PG&E Electric Transmission Grid Expansion Plan
Draft 2002 PG&E Electric Transmission Grid Expansion Plan (adjusted)

Given the geographical location of San Francisco at the end of a peninsula with transmission lines that serve the City coming from the south through one substation at the San Mateo-San Francisco County line, it is necessary to take into account demand for electricity in Northern San Mateo County in planning for new electricity resources.

Figure 3.5 shows the forecasted peak demand for electricity in San Francisco and in northern San Mateo County (north of the San Mateo substation).

San Francisco and Peninsula Forecast Peak Demand (Megawatts)

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
San Francisco	946	980	1035	1061	1073	1085	1097	1109	1121	1133	1145
Northern Peninsula	280	285	290	295	301	306	312	317	323	329	335
Total	1226	1265	1325	1356	1374	1391	1409	1426	1444	1462	1480

Figure 3.5
Source: PG&E (2001 forecast)

This forecast of peak demand for electricity serves as the basis for planning the quantity and types of new resources that will be needed to assure reliability of electric service in San Francisco. Those new resources can include energy efficiency and load management programs that reduce peak demand, new in-City generation, and new transmission lines.

Generation of Electricity in San Francisco

The existing sources of power generation in San Francisco are two large power plants that run on natural gas (Potrero Unit 3 and Hunters Point Unit 4) and four smaller peaking power plants that use diesel fuel (see figure 3.6).

Figure 3.6 San Francisco Power Infrastructure

These plants are old, inefficient and vulnerable to outages. Moreover, the plants face increasing challenges in meeting air quality requirements in the future. Potrero Unit 3 began operations in 1965 and is now beyond the expected 30-year life of a steam thermal power plant. Hunters Point unit 4 is 44 years old. A power plant this old tends to break down frequently and requires significantly more maintenance than a new power plant. Since 1998 the Hunters Point power plant has produced less electricity each year (about 8 % of San Francisco's use in 2001). The current mix of power plants on the San Francisco Peninsula is described in figure 3.7 below.

Given the geographical location of San Francisco and the age of the two principal power plants serving the City, the ISO has adopted special criteria to assure reliable electric service for San Francisco. Those criteria require that San Francisco have sufficient power generating capacity in the city to meet load whenever the largest power plant fails and at the same time that the next largest power plant is unavailable due to regular overhaul schedules or vice versa. Regular overhauls are generally scheduled during the spring months when demand for electricity is at it's lowest.

These criteria mean that it is necessary to have sufficient resources in San Francisco to keep the lights on if Potrero Unit 3 breaks down when Hunters Point 4 is out of service for a maintenance overhaul. In addition, the criteria assume that one of the four peaking plants will not be able to quick start. Under these conditions, three in-City peaking plants would be used in combination with the import of electricity. Currently, a maximum of about 800 megawatts of San Francisco load can be served under these conditions.

Existing Power Generation in San Francisco

Plant	Unit	Size (MW)	Fuel Type	In Service Date	Restrictions
Potrero	3	207	Natural Gas	1965	N0x restrictions
	4	52	Diesel	1976	877 hours/year
	5	52	Diesel	1976	877 hours/year
	6	52	Diesel	1976	877 hours/year
Hunters Point	4	163	Natural Gas	1958	N0x restrictions
	1	52	Diesel	1976	877 hours/year

Figure 3.7
Source: PG&E

The Proposed New Power Plant at Potrero

Mirant, an independent power plant developer, has proposed to build and operate a 540-megawatt combined cycle power plant (Potrero Unit 7) at the site of the existing Potrero facility on the eastern shore of San Francisco. The proposed plant would consist of two combustion turbine generators and one steam turbine generator. Exhaust heat from each combustion turbine flows through two heat recovery steam generators that produce steam for the steam turbine generator. This type of power plant is often referred to as a "two-on-one" combined-cycle configuration.

The California Energy Commission (CEC), in February 2002, released its final staff assessment of Mirant's proposal to build the Potrero Unit 7 project. The CEC staff recommended that the plant meet certain conditions before it is granted a license. These include replacing the proposed once-through cooling system with an alternative cooling system and local mitigation of particulate emissions from the plant. Hearings are in progress at the time of the issuance of this Plan. If the plant is licensed, it probably would take at least another three years or more before it becomes operational. However, Mirant, like other energy companies, is experiencing a lack of investor confidence and may find difficulty financing the plant.

Transmission of Electricity to San Francisco

The upper San Francisco peninsula is like a funnel for electric transmission into the City. High voltage transmission lines converge at the San Mateo substation from the south and from the east. From the south transmission lines from the Tesla, Newark and Ravenswood substations connect into the San Mateo substation. From the east two transmission lines cross the San Francisco Bay and also connect at San Mateo. Power flows from the San Mateo substation northward to San Francisco through one underground 230 kV transmission line, five overhead 115 kV transmission lines and one 60 kV transmission line to the Martin substation at the San Francisco-San Mateo County line (see figure 3.8).

Total existing transmission capacity into the Martin substation is about 1250 megawatts under normal conditions. However, this maximum import capability does not mean that the system can normally be operated at this level. The loss of one transmission line would expose the City to the risk of widespread outages. Typically transmission systems operate under "first-contingency" planning conditions. Those rules dictate that the maximum load on a transmission system should be the load that can be met, accounting for the possible failure of the largest component of the system. Operating under first contingency conditions, about 900 megawatts of peak demand in San Francisco and upper San Mateo County can be met with adequate reliability. Subtracting 280 MW to serve load in San Mateo County results in an import capability into San Francisco of about 620 megawatts. As Peninsula load grows, the amount of power that the City can import will decline. On the other hand, if new generation projects were located in upper San Mateo County then transmission capacity would be freed up for electricity delivery into San Francisco.

Proposed New Transmission Line

In April 1999 the California Independent System Operator (ISO) formed a study group to evaluate long-term electric system adequacy for San Francisco, and to identify alternative transmission projects to meet future demand for electricity. Participants included PG&E, the City of San Francisco, the California Public Utilities Commission and the California Energy Commission and others. In October 2000 the study group submitted a final report entitled "San Francisco Peninsula Long-Term Electric Transmission Planning Technical Study".

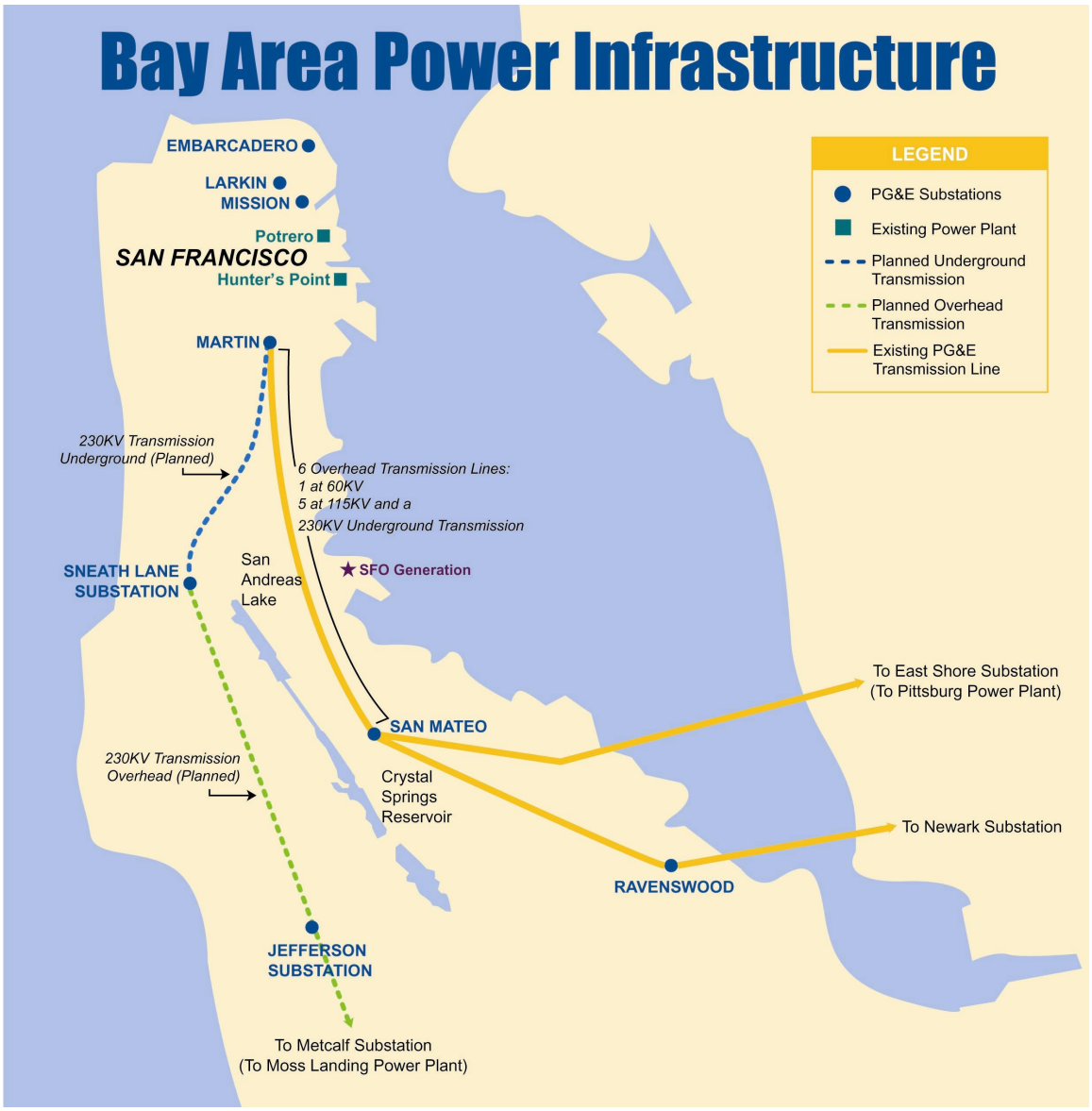


Figure 3.8 Bay Area Power Infrastructure

That study found that unless new generation resources were built in San Francisco that a new 230 kV transmission line would be needed to meet customer demand by 2006. The stakeholder group analyzed several alternative routes for transmission facilities. The group recommended that the most cost-effective project was a 28-mile long 230 kV line originating at the Jefferson substation near Redwood City and terminating at the Martin substation at the San Francisco County border. (see figure 3.8)

In May 2002, the ISO board made the finding that this project is needed and that the ISO staff work with San Francisco to facilitate the shutdown of the Hunters Point Power Plant. However, before the transmission line can be built, PG&E will need to obtain a certificate of convenience and necessity from the CPUC. As part of the certification the CPUC will have to evaluate the environmental impacts of the project under CEQA. The CPUC also has to determine whether the project is needed for reasons of electric system reliability. If it makes that determination, then the cost of the project will be placed into PG&E's ratebase and charged over time to all of PG&E's ratepayers, not just those in San Francisco

PG&E delivers power from generators throughout the state. The power imported to San Francisco through the transmission lines comes from a mix of generation sources (see figure 3.9). The electricity transmitted into San Francisco is actually derived from the grid as a whole, a mix of all of the statewide resources that collectively energize the transmission lines. It includes electricity from San Francisco's Hetch Hetchy dam system as well as all of the power plants in the rest of California and some of those in the western states region. Currently, the renewable portion of that mix is about 12%, primarily made up of wind, with some biomass and solar.

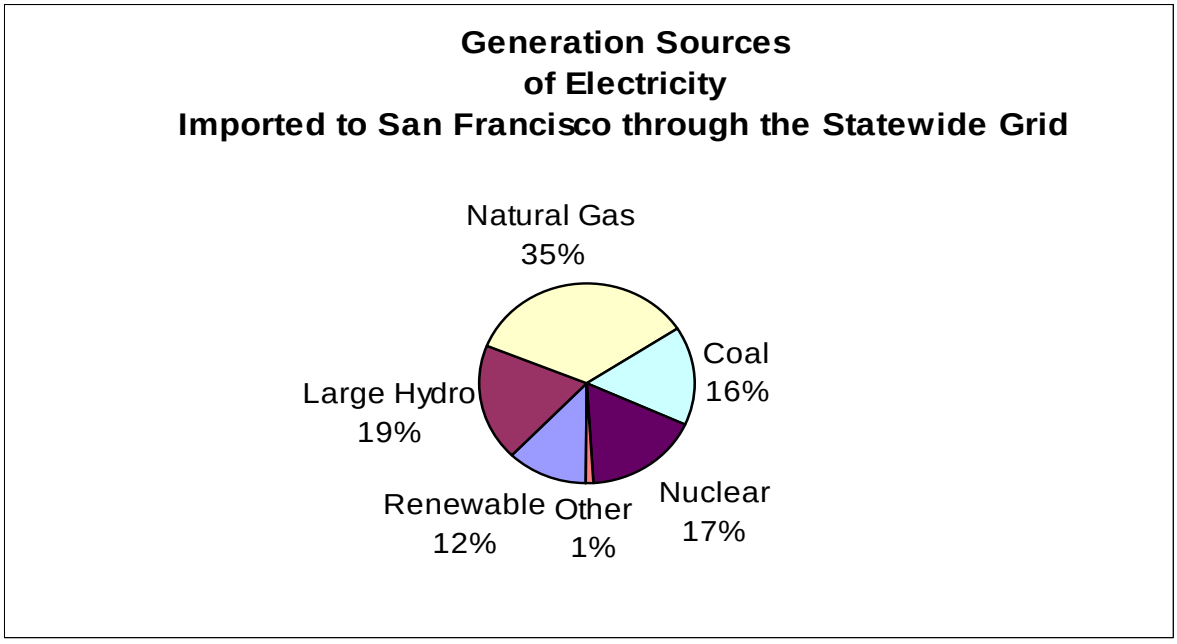


Figure 3.9
Source: PG&E

Reducing Electricity Demand

Reducing demand means that in-city power plants can run less, creating fewer emissions, and improving local air quality in Southeast San Francisco. This supports both the reduced air pollution and environmental justice goals described in Chapter 1. Investing in energy efficiency and practicing conservation are generally the easiest and most cost-effective ways to lower the amount of generation needed. Installing small power systems in homes and businesses (distributed generation or DG) also reduces the use of power plants. Renewable sources such as solar panels and small co-generation systems are the most common and available DG applications.

Ongoing demand-side management (DSM) programs administered by PG&E over the last two decades have helped to keep San Francisco's demand growth to a minimum. The demand forecasts in this report assume that these programs will continue at existing levels. Since deregulation, PG&E programs have been supported by ratepayers through a Public Goods Charge (PGC) on their monthly electricity bills. These ratepayer funds have been used by PG&E to administer efficiency programs throughout the utility territory under the direction of the CPUC. Since the rolling blackouts in 2000, the state has provided additional funds to government agencies to support energy efficiency and renewable projects.

In San Francisco, energy efficiency programs for City-owned facilities are managed by SFPUC while the Department of Environment (SFE) oversees several efficiency programs for the private sector. In 2001, SFE received $7.8 million of the state funds to manage an energy efficient lighting program for small businesses in San Francisco Both SFPUC and SFE are now engaged in a cooperative effort with state agencies, PG&E, community groups, and the business community to identify projects in San Francisco that can take advantage of PG&E's programs and state resources. Any additional reduction in electricity demand that the City can stimulate with new programs and initiatives will lower future demand, with the objective of meeting all new demand with clean energy sources.

Energy Efficiency

Energy efficiency measures create long-lived reduction in electricity use because efficiency is built into the equipment. This differs from conservation, which is usually dependent upon human behavior. Reducing demand can be achieved in either case by:

- Installing equipment that is more efficient, e.g. the newest high efficiency fluorescent lighting uses 40% less energy than older versions.
- Turning off or turning down equipment during the peak hours, e.g. turning off computer monitors when not in use.
- Installing systems that use energy off-peak to avoid use during peak periods.

Demand reduction also:

- Saves the City, businesses, and residents money on their monthly utility bills, which supports the economic development goal to make more dollars available for local investment and job creation.
- Avoids or defers building and operating generation systems, even renewable ones, which reduces the environmental impacts of construction.
- Reduces the stress on the transmission and distribution system, thereby improving reliability.

Energy efficiency programs can range from education to new appliance standards and energy codes, to incentives. Typical programs are: rebates for the purchase of energy-efficient products, energy auditing services, and incentives for upgrading the operational efficiency of buildings, processing plants, and other facilities. There are also programs that encourage the purchase of new high-performance homes, and others that provide design and engineering support for qualifying commercial buildings and multifamily complexes. PG&E has ongoing education programs for consumers and for schools. Specialized training classes for contractors, architects and other professionals are offered at several PG&E facilities, including the San Francisco-based Pacific Energy Center.

Renewables and Other Distributed Generation

Small-scale distributed generation (DG) is designed to power single buildings or connected structures. To reduce the amount of load on the system, the facilities are usually energy-efficient as well. In general, renewable energy sources are the cleanest form of electric generation and have a number of suitable applications in the City. Solar panels are the most readily available technology for reducing City electricity demand in the near term. Small-scale wind turbines that can be installed on roofs or on property near a building are now on the market, but standard wind technology is more appropriate outside the City. While the electricity generated from outside would not contribute to City load reduction, it would raise the percentage of renewable power feeding the transmission grid.

Biomass projects, where they can be sited, have proven successful in the City. But more appropriate urban technologies, such as fuel cells, will take several years before becoming commercially available and affordable. Other technologies now in the development stage, such as tidal and marine current energy, would be well suited to San Francisco and could support the City's longer-term goal of zero fossil fuel generation.

Co-generation, or combined heat and power systems, can be an efficient source of DG for facilities that have heating/hot water needs, such as hospitals and hotels. These systems do use fossil fuels, however.

By definition DG reduces the need for central power plants, but not all distributed generation is cleaner. Emergency generators at hospitals and in many office buildings

burn diesel fuel, which emit higher number of pollutants per kW than new natural gas power plants. Despite the ability of these generators to meet certain reliability situations, their use is patently discouraged in this Plan except in genuine emergencies

As with energy efficiency, there are funding sources available for renewable energy and co-generation projects. There are state programs that provide financial incentives for installation, and others that help finance projects.

City Initiatives on Clean Energy

In November 2001, the electorate of San Francisco voted on energy-related ballot initiatives that would provide financing for renewable energy and energy-efficiency projects. Proposition B authorized the issuance of $100 million for the acquisition, construction and installation of projects for City agencies, departments and enterprises. Proposition H simply authorized the San Francisco Board of Supervisors to issue revenue bonds for renewable energy and energy-efficiency projects for private sector or City projects without requiring a vote of the electorate.

The SFPUC has already identified specific solar photovoltaic and wind projects that would qualify for financing under Proposition B. Both SFPUC and SFE will be working with the private sector and appropriate City agencies to facilitate the installation of renewable and energy-efficient technologies in commercial and residential properties. These are discussed in the Action Plan in Chapter 5.

In January 2002, the Mayor and Board of Supervisors joined other cities in setting a goal of reducing San Francisco's greenhouse gas emissions to 20 percent below 1990 levels by 2012. Actions to achieve this ambitious goal will include increasing the amount of renewable energy in the City's portfolio and ramping up energy-efficiency efforts as well as supporting transportation and solid waste programs. The Department of the Environment is preparing a Climate Action Plan that will identify what the City will have to do to achieve the 2012 goal.

This *Electricity Resource Plan* reaffirms the will of the voters and City leaders with a prescribed path for reducing our dependence on electricity generated from fossil fuels. Its implementation would lend substance to commitments made to communities, especially neighborhoods in the Southeast. There are challenges, but there are also viable solutions. These are discussed in the following chapters.

4 Challenges and Choices

The *Electricity Resource Plan* will have to be flexible to adapt to the fast pace of developments that bear directly on San Francisco's energy future. In the coming months, decisions by state and federal authorities, and by owners of City power plants (PG&E and Mirant), could require adjustments to the way the proposed plan is implemented.

City staff is tracking key areas of policy and have identified several areas in which challenges could demand actions to assure that the goals of this Plan are achieved.

Changing Markets and Regulations

The California electricity market is in a period of change that creates a strong element of unpredictability to any planning process. PG&E's future responsibilities for planning for long-term energy needs are unclear. Many independent power developers have postponed new generation projects while investors have grown cautious about investments in the electricity industry. Federal and state regulatory agencies are changing the rules for overseeing electricity markets.

Given that many circumstances may be beyond the City's control, it is important that this Plan be governed by a strong commitment to the overarching goals. A set of strategies for achieving those goals must be flexible enough to adapt to the shifting landscape. What follows is a review of key challenges that may impact the implementation of this Plan.

Market Power and Reliability-Must-Run Contracts

Power generators can exercise market power in local areas at times when there is insufficient transmission capacity to create a competitive market. This is the case for San Francisco for many hours of the year. To mitigate market power the ISO has instituted Reliability-Must-Run (RMR) contracts. However, there has been criticism that these contracts are an inefficient way of mitigating market power and assuring reliability. Recently new methods have been proposed that could create increased risks, or alternatively opportunities for San Francisco.

Once the Hunters Point Power plant is closed, Mirant would be the only significant generator of electricity in San Francisco. In addition, their ownership of several power plants in the East Bay would give them significant market power in the Bay Area. This market power must be mitigated through regulatory intervention into markets, through divestiture of power plants and/or through the construction of new transmission projects. Energy efficiency measures and distributed generation in San Francisco can also mitigate market power.

The ISO currently controls the operation of the Potrero and Hunters Point power plants through RMR Contracts. Under these contracts, the owners of the power plants are paid for making them available for dispatch by the ISO.

When needed to maintain sufficient electricity for the San Francisco Peninsula or the greater Bay Area, the ISO orders the plant to operate and pays the variable cost of operating. However, since older thermal power plants take a long time to heat up, they are often kept running at minimum loads even when their output is not needed for system reliability. From minimum load levels, they can be ramped up in the event that another power plant unexpectedly trips off-line. The ISO investigates the need for RMR contracts on an annual basis and as new generation, transmission and load reduction resources are developed makes a determination whether or not to renew the contract. If the City were to acquire these plants, the City would also be required to participate in the RMR contracts.

Power Contracts

Investors are currently reluctant to invest in new power plants that are not secured through long-term contracts. Such contracts can take many forms. Some contracts require the buyer to take power at specified quantities and pay for the power even if it is not needed. Other contracts require that the buyer pay for the capital and fixed operating costs of the plant and only pay for the variable costs including fuel when power is scheduled. It is possible that excessive commitment to these types of contracts would discourage investments in energy efficiency and renewable energy technologies.

Price Volatility

Although California has a relatively diverse portfolio of electricity resources, natural gas-fired power plants constitute an increasingly larger share of the market. As a result, the California electricity market is becoming increasingly vulnerable to fluctuations in the price of natural gas. To the extent that San Francisco continues to depend on natural gas as a fuel for electricity, ratepayers will be subject to fluctuations in the natural gas market.

Energy Efficiency in the Market

Funding for energy efficiency programs for years has been administered by electric utilities. More recently new state sources of funding have been established for which the City may compete.

Investments in energy efficiency can be evaluated from a number of different perspectives. The method that is most favorable to environmental improvement is to compare the cost of energy efficiency programs to sources of generation over a long time horizon and to include the cost of environmental and public health damage in the comparison. However, sometimes these programs have been evaluated in comparison with the short-term marginal cost of increasing output from existing power plants. Over

the last two decades, different approaches by state regulators have lead to several boom and bust cycles in the efficiency field. Energy efficiency businesses and programs have started up, flourished, and then died as economic and political conditions have changed. These upheavals have required a regular re-invention of institutions, staffing and the service delivery infrastructure.

Environmental Justice

The Closure of Hunters Point

Currently, all of the in-City power plants are located in the southeast sector. To address this environmental justice issue, in July 1998, the City and County of San Francisco entered into an agreement with PG&E to close the Hunters Point Power Plant when it is no longer needed to sustain electric reliability in San Francisco. PG&E cannot permanently close the plant until authorized by the ISO and FERC. Within one year of permanent shutdown, PG&E has agreed to expeditiously decommission the plant and remediate the site.

Since this agreement between the City and PG&E, the utility has shut down the two oldest units at Hunters Point (Units 2 and 3) and converted them to synchronous condensers to provide needed voltage support to the transmission grid. That equipment may have to be relocated when the facility is decommissioned.

Air Quality Regulations

Potrero Unit 3 and Hunters Point Unit 4 are subject to more stringent NOx emission limitations beginning January 1, 2005. To meet this requirement and continue operating, the plants may have to shut down in 2004 and be retrofitted with expensive pollution control equipment. Or, the plants may be able to continue operation for a time using emission reduction credits if the plant owners acquired and "banked" such credits. Without the retrofit, the Potrero plant could be de-rated from 207 MW to 47 megawatts in 2005 to come into compliance.

The possible shutdown of Potrero in 2004 presents two problems for San Francisco. First, during the period of time that the plant is out of operation, electric reliability in San Francisco will be highly dependent on the operation of the Hunters Point Power plant. Given its age this plant has a higher rate of forced outages than do newer power plants. If the Potrero Plant is not available because of its retrofit schedule and the Hunters Point Power plant experiences a forced outage during a period of peak demand, then it is likely that blackouts would be experienced throughout San Francisco.

Secondly, the retrofit of the Potrero Unit 3 would be costly. Mirant would only make an investment in such a retrofit if it were guaranteed by the ISO that it could recover those costs through an RMR contract or similar mechanism. This investment would be

amortized over time and could result in the operation of Potrero Unit 3 instead of the development of more efficient and reliable sources of generation.

PG&E, as the owner of the Hunters Point Unit 4, has indicated a strong desire to avoid having to invest in emission reduction retrofits at this 44-year-old plant. PG&E may be able to operate Hunters Point using emission reduction credits into 2005 and 2006. The number of hours they can operate will be determined by the Bay Area Air Quality Management District.

Diesel-Fueled Power Generators

In San Francisco diesel-fueled generators are used to meet peak demand and to provide emergency back-up power for critical facilities. There are four 52 megawatt diesel-fueled combustion turbines, or "peakers," located in Potrero and Hunters Point. These units are limited in their operation to 10 percent of the hours in a year by the Bay Area Air Quality Management District. Because diesel fuel produces many times more pollutants than natural gas, significant air quality improvements could be achieved if these units were not used to meet peak demand but reserved for emergencies, as they can be replenished by truck after a disaster that disrupts natural gas supplies.

The Variables and Risks of New Resources

The development of new sources of power face several obstacles that can delay projects. Some of the challenges that any developer faces are:

- Financing – Given the recent turmoil in deregulated electricity markets it has become more difficult for power plant developers to obtain financing.
- Environmental review (CEQA, CEC Application For Certification process, CPUC for transmission lines) related to siting – Licensing of power plants and transmission lines can take from six months to several years. California law provides for intervention by public interest groups. This process can lengthen the proceedings.
- Possible Litigation – Even after power plants have been licensed public groups can litigate on environmental issues.
- Interconnection (PG&E) – Connection of a power plant to gas pipelines and the high voltage electric grid requires complex studies and sometimes costly upgrades to those systems.
- Construction logistics – Projects that involve complex engineering, procurement and construction can face challenges that have the potential to delay the start-up date.
- Securing revenues through power purchase agreements or RMR contracts (ISO) – Under current market conditions some power plants cannot recover their fixed costs solely through short-term energy markets. Often plants that are built for peak needs or to enhance reliability need to be supported through long-term power purchase contracts.

Proposed Potrero Expansion

After Mirant purchased the Potrero power plant it proposed to construct a new 540-megawatt combined cycle facility at the site. This new power plant was expected to be a replacement for the Hunters Point power plant. Mirant, has encountered several problems that have delayed the project. The application process has been delayed more than a year longer than anticipated. Mirant along with many other independent power developers are facing difficulties in obtaining credit due to the uncertainties of electricity markets. The lack of readily available financing for power plants that are not supported through long-term contracts raises the question whether this plant will be built even if the license is granted.

Transmission

There are two planned transmission projects that can help alleviate San Francisco's reliability and capacity shortage problems. A planned upgrade to one of the existing transmission lines that serves San Francisco is scheduled for 2004 and could bring as much as 100 megawatts (MW) of new capacity. The proposed Jefferson-Martin transmission line is planned for completion in the fall of 2005 and will add up to 350 MW. However, approvals for right-of-way through several Peninsula communities may cause significant delays. While the construction of both of these transmission projects would facilitate the closure of Hunters Point, any problems in the development of the Jefferson –Martin project would delay the closure.

Reserve Margin

Electric power systems need to have excess generating capacity to assure reliability in the event that a power plant breaks down or a transmission line shorts out. The amount of excess generation needed for reliability is often referred to as a reserve margin. Over large regions reserve margins are usually expressed in terms of the percent of generation that is in excess of peak demand. A typical reserve margin used in some parts of the country is 15 percent. San Francisco is unique in the reserve margin that is required to maintain reliability. Because San Francisco's grid is at the tip of a transmission system and because of the advanced age of the City's power plants there are special reliability criteria for San Francisco. Figure 4.1 shows what the projected reserve margin would be if the recommended electricity resource portfolio is put into place and the planned transmission projects are completed.

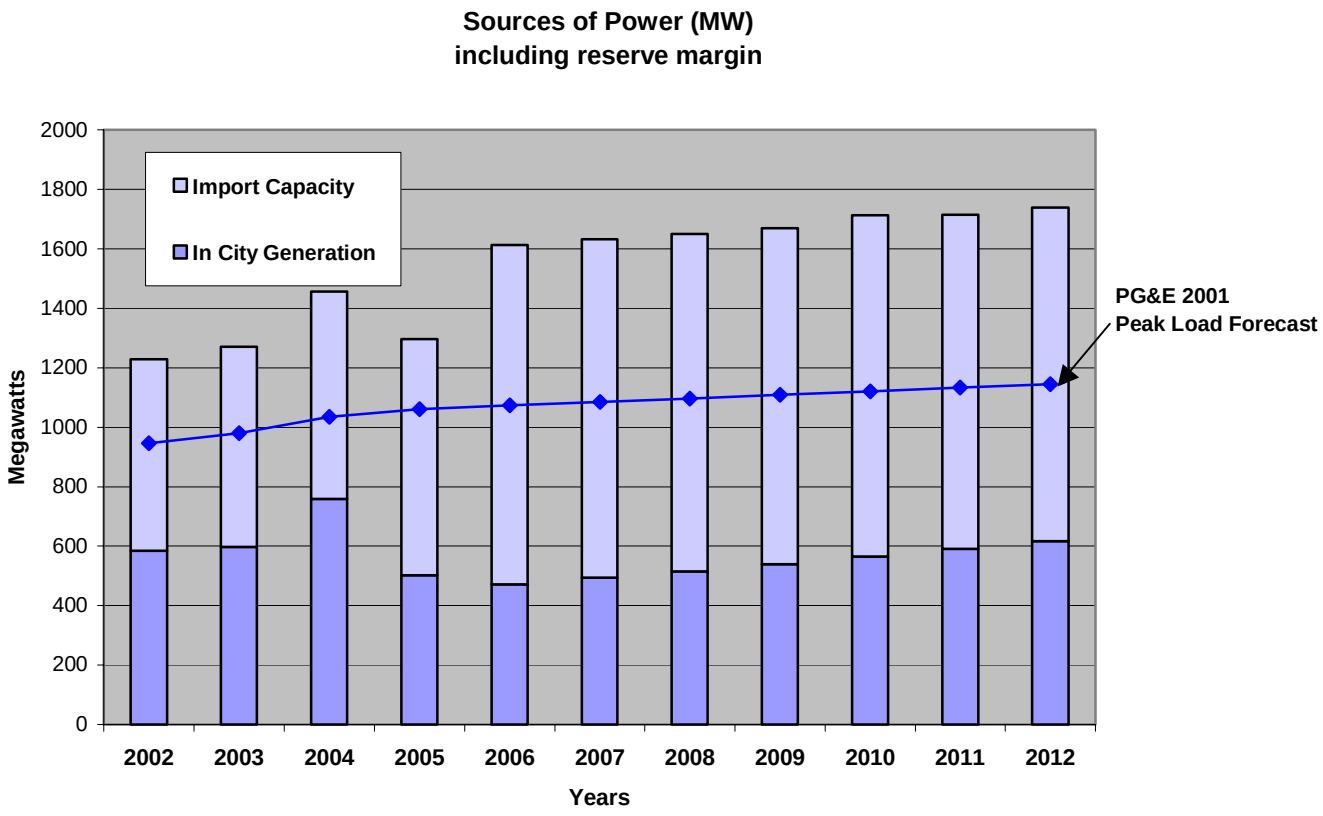


Figure 4.1

ISO Reliability Criteria

The ISO has developed special criteria for planning the design of San Francisco's electric system. These criteria assume simultaneous outages of multiple system components. Of the five criteria adopted by the ISO the two most important are that:

1. Sufficient in-City generation is available to meet all city loads in the event that *both* the largest power plant and one underground transmission line are out due to natural or man-made causes, in addition to any generation unavailable due to regular overhaul schedules.

   Currently, there is sufficient transmission and in-City generating resources to deliver approximately 800 megawatts of electricity in the event that the 230 Kv underground cable is out of service and Potrero Unit 3 trips off-line while Hunters Point is scheduled for overhaul. This amount is less than the peak demand for electricity in 2001.

2. Sufficient in-City generation allows for the controlled interruption of customer demand, excluding downtown network loads and critical public services, during the loss of all overhead transmission, in addition to any generation unavailable due to regular overhaul schedules.

The loss of all six overhead transmission lines into San Francisco would leave an import capability of approximately 350 megawatts over the remaining underground cable. If this occurred while Potrero Unit 3 and one of the diesel peakers were out of service there would be sufficient capacity to serve approximately 670 megawatts of load in San Francisco.

PG&E and the ISO are now working with the City and community representatives to evaluate the load-serving capabilities of the current San Francisco electric system. Analyses to be produced from that process will more accurately describe the ability of meeting future electricity demand through alternative sets of resources. The ISO has agreed to review the resources and timeline the City is proposing in this Plan to replace the Hunters Point and Potrero power plants. It is possible the ISO will need to establish new reliability criteria in the absence of large generating plants.

Possible Power Shortage in 2004

Resources Needed to Meet Forecast Demand (Megawatts)

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
SF Peak Demand (PGE 2001 forecast)	946	980	1035	1061	1073	1085	1097	1109	1121	1133	1145
SF Peak Demand (PGE 2002 forecast)	867	900	933	951	967	986	1006	1024	1043	1059	1077
Existing Import Capability	646	675	698	695	692	689	685	682	699	675	672
Existing Peakers	156	156	156	156	156	156	156	156	156	156	156
Resources needed (2001 PGE forecast)	144	149	181	210	225	240	256	271	266	302	317
Resources needed (2002 PGE forecast)	65	69	79	100	119	141	165	186	188	228	249

Figure 4.2

Because the Hunters Point plant operates as a back-up to the Potrero plant, if Potrero Unit 3 is shutdown for retrofit in 2004, it would place excessive demand on the Hunters Point Power Plant and the diesel-powered peaking plants located at Potrero and Hunters Point. The Hunters Point plant, then 46 years old, would have to produce at least twice the amount it produced in 2001. During a peak period, if the Hunters Point plant fails, there will be insufficient power for San Francisco.

If Potrero Unit 3 is not retrofitted in 2004, it will not meet the 2005 requirements and may be de-rated in 2005 from 207 MW to only 47 MW. In this case, Hunters Point would then run heavily in 2005 and beyond unless resources can be put in place to replace Hunters Point as well as the 160 MW lost in the de-rating of Potrero.

Figure 4.3 below indicates hours of service and the megawatt hours of electricity produced by the power plants at Potrero and Hunters Point in 2001.

Power Plant	Rated Power (MW)	Hours of Service	MWh Generated	Equivalent Hours at Full capacity [5]
Hunters Point 1	52	909	36,430	701
Hunters Point 4	163	5,801	392,595	2,409
Potrero 3	207	6,790	1,019,079	4,923
Potrero 4	52	911	30,022	577
Potrero 5	52	1,086	50,309	967
Potrero 6	52	1,072	52,875	1,017

Figure 4.3

Source: ISO

There have been two peak demand forecasts for San Francisco performed by PG&E (see figure 4.2 above). The 2001 forecast used 946 MW as the starting point while the 2002 forecast used 867 MW as its starting point. Typically the ISO uses a long-term forecast that assumes worse than normal weather conditions for projecting peak electricity need. Currently, the ISO use the higher 2001 forecast for its planning purposes and is expected to use this forecast to determine if there are sufficient resources to close Hunters Point. If the ISO were to use the lower, more recent forecast, then the anticipated resources needed in 2005 would drop by 110 MW.

In either case, without new resources totaling 150-250 MW, a prolonged outage of Potrero Unit 3 in 2004 would cause the Hunters Point plant to run more extensively.

[5] "Equivalent hours at full capacity" is the number of hours that each plant would have to run at full capacity to produce the amount of electricity it generated in 2001. Potrero units 5 and 6 exceeded the number of hours they were permitted to operate under their air permits.

5 Action Plan

San Francisco will need new electricity resources over the next decade to meet growth in demand for electric services, to shut down the outdated Hunters Point Power Plant and to replace the aging power plants located at Potrero. The strategy for developing the necessary resources to rapidly modernize San Francisco's electric infrastructure needs to take into account the longer-term objective of environmentally sustainable electricity for future generations. While the short-term solutions need to be cost-effective, they must also be consistent with the goals set forth in Chapter 1 as well as with the Mayor's goal for reduced greenhouse gas emissions. Therefore, taking into consideration the challenges identified in the previous chapter, the preferred course of action outlined here proposes solutions that immediately address the City's urgent needs while complementing and advancing the achievement of mid- and long-term objectives. Specific recommendations in the areas discussed follow in Chapter 6.

Short Term Action Plan – 2002 through 2005

The City must take aggressive steps immediately to shutdown the Hunters Point Power Plant while assuring reliable electric service. In addition, the City should facilitate the early retirement of Potrero Unit 3, to avoid costly upgrades and the extended operation of this outdated plant. This could lead to forced outages in 2004, and then allow the plant to continue operation well into the future when cleaner, more reliable resources are available.

Therefore, it is in the City's interest to develop a short-term action plan that would avoid the shutdown of Potrero Unit 3 in 2004 and minimize San Francisco's dependence on its operation over the longer term. Our objectives are to maintain reliability through decreasing reliance on old, polluting technologies and increasing investments in energy efficiency and clean, efficient technologies.

An action plan that could achieve these objectives would include:

- Maximum investments in energy efficiency measures particularly peak reducing measures
- Development of new highly efficient and operationally flexible generation at appropriate sites by the summer of 2004 to facilitate the closure of the Hunters Point Power Plant Unit 4 by the end of 2004.
- Development of a plan between the City and Mirant to allow for the environmental dispatch of new generation owned by the City and Potrero Unit 3 to meet BAAQMD requirements under the SIP and ISO requirements for reliability.
- Aggressive efforts to promote and facilitate installation of distributed generation using renewable technologies and clean natural gas-based technologies

Medium Term Action Plan - 2006 through 2012

The most important challenges facing the City in the medium term is to develop sufficient new resources to permanently close Potrero Unit 3 and to limit the operation of the diesel-fired peaking plants at Potrero to genuine emergencies. In addition, the City must take aggressive steps to meet its commitment to reduce greenhouse gases, which means commitments to fossil fuel reduction both in the City and in the power sources feeding the transmission grid. The key components of a mid-term action plan include:

- Completion of the Jefferson to Martin transmission line
- Accelerated development of solar electric generation in San Francisco with the objective of having 50 megawatts installed by 2012
- Development of additional renewable energy, cost-effective co-generation, and clean distributed generation technologies in San Francisco
- Maximizing investments in energy efficiency and demand reduction with a goal of maintaining peak demand at a level no higher than 909 megawatts (the average of 1996-2000).
- Development of at least 150-megawatts of new wind or other renewable generation that can be imported into San Francisco

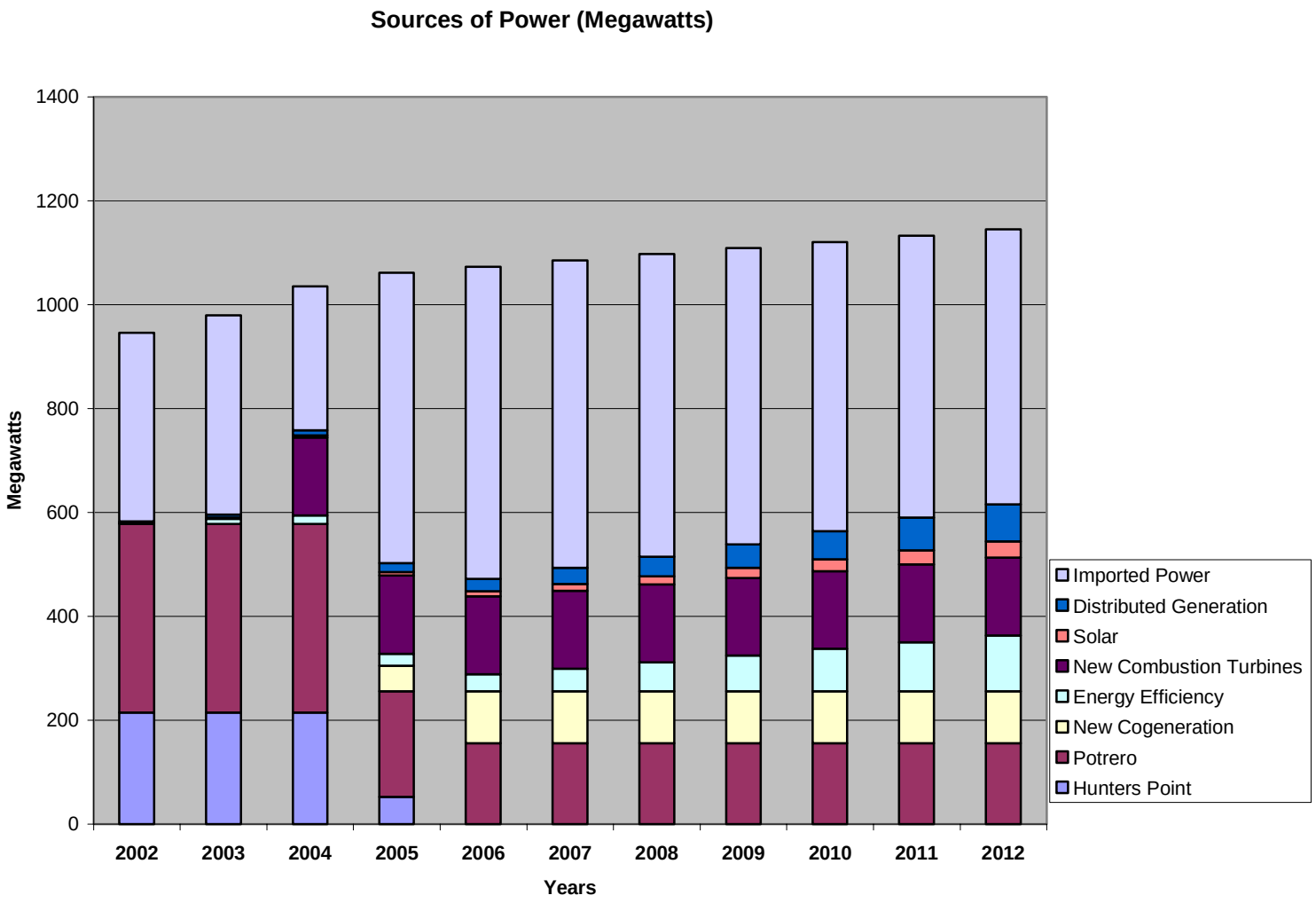
The following graphs present the results of the short-term and medium-term action plan.

Figure 5.1 shows the contribution that each resource makes towards meeting the projected peak demand for electricity in San Francisco from 2002 through 2012. The Chart shows 150 megawatts of new operationally flexible combustion turbines coming on line in 2004. In 2005 an additional 100 megawatts of import capability is assumed to be in place from the upgrade of the San Mateo to Martin power line number 4. The new combustion turbines and the upgraded power line allow for the retirement of the 163-megawatt Hunters Point Unit 4 and the down rating of Potrero Unit 3 from 207 to 47 megawatts. This results in a net decrease of 109 megawatts of in-city fossil fuel generation in 2005 and a 72% reduction in annual NOx emissions.

Two new 50-megawatt cogeneration power plants are developed in 2005 and 2006 that allow for the retirement of Potrero Unit 3 and the peaking unit at Hunters Point in 2006. The peaking unit may be retired earlier if the operational plan for Potrero Unit 3 permits it to run at a higher capacity than estimated. By 2012 energy efficiency, distributed generation and solar account for 210 megawatts of capacity.

Figure 5.2 shows the amount of electricity produced or saved by each resource category. With the addition of the new combustion turbines and additional import capacity in 2005 the amount of generation from the Potrero and Hunters Point power plants is only 13 percent of their 2002 level of generation. The addition of efficient cogeneration plants in 2005 and 2006 eliminate all generation at Hunters Point and further reduce generation at Potrero. The expansion of energy efficiency measures, distributed generation and solar lessens the amount of power generated by the combustion turbines as well as the amount of imported power each year through 2012.

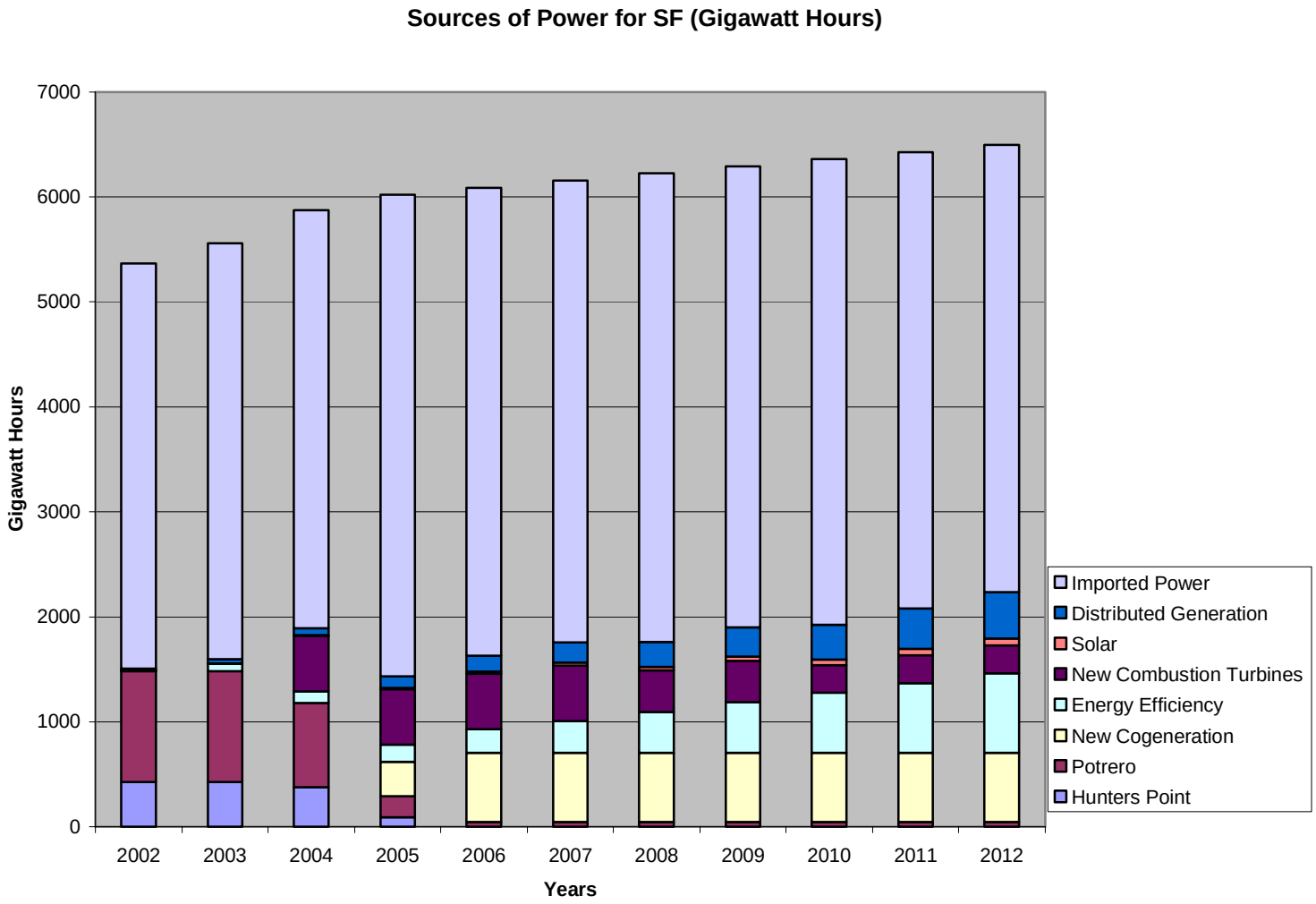
Recommended San Francisco Electricity Resource Portfolio



	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Hunters Point	215	215	215	52	0	0	0	0	0	0	0
Potrero	363	363	363	203	156	156	156	156	156	156	156
New Cogeneration	0	0	0	50	100	100	100	100	100	100	100
Energy Efficiency	1	10	16	23	32	43	55	68	81	94	107
New Combustion Turbines	0	0	150	150	150	150	150	150	150	150	150
Solar	1	2	4	7	10	13	16	19	23	27	31
Distributed Generation	3	6	10	17	24	31	38	45	54	63	72
Imported Power	363	384	277	559	601	592	582	571	557	543	529
totals	**946**	**980**	**1,035**	**1,061**	**1,073**	**1,085**	**1,097**	**1,109**	**1,121**	**1,133**	**1,145**

Figure 5.1

Recommended San Francisco Electricity Resource Portfolio



	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Hunters Point	428	428	377	91	0	0	0	0	0	0	0
Potrero	1,052	1,052	800	200	47	47	47	47	47	47	47
New Cogeneration	0	0	0	329	657	657	657	657	657	657	657
Energy Efficiency	7	71	113	163	227	305	390	482	574	666	759
New Combustion Turbines	0	0	526	526	526	526	394	394	263	263	263
Solar	2	4	9	15	22	28	35	42	50	59	68
Distributed Generation	20	39	64	107	150	193	236	279	334	389	444
Imported Power	3,857	3,964	3,982	4,588	4,458	4,398	4,463	4,390	4,433	4,345	4,257
totals	**5,366**	**5,559**	**5,871**	**6,019**	**6,086**	**6,154**	**6,222**	**6,290**	**6,358**	**6,426**	**6,495**

Figure 5.2

Imported Energy

Figure 5.3 details the principal sources of imported power used to meet San Francisco's electricity needs. Wind generation is added in the following increments – 50 megawatts in 2004, 90 megawatts in 2006, 125 megawatts in 2008 and 150 megawatts in 2010. Assuming that renewable resources account for 12 percent of the purchased imports, renewable energy will account for almost 50 percent of imported power by 2012 [6].

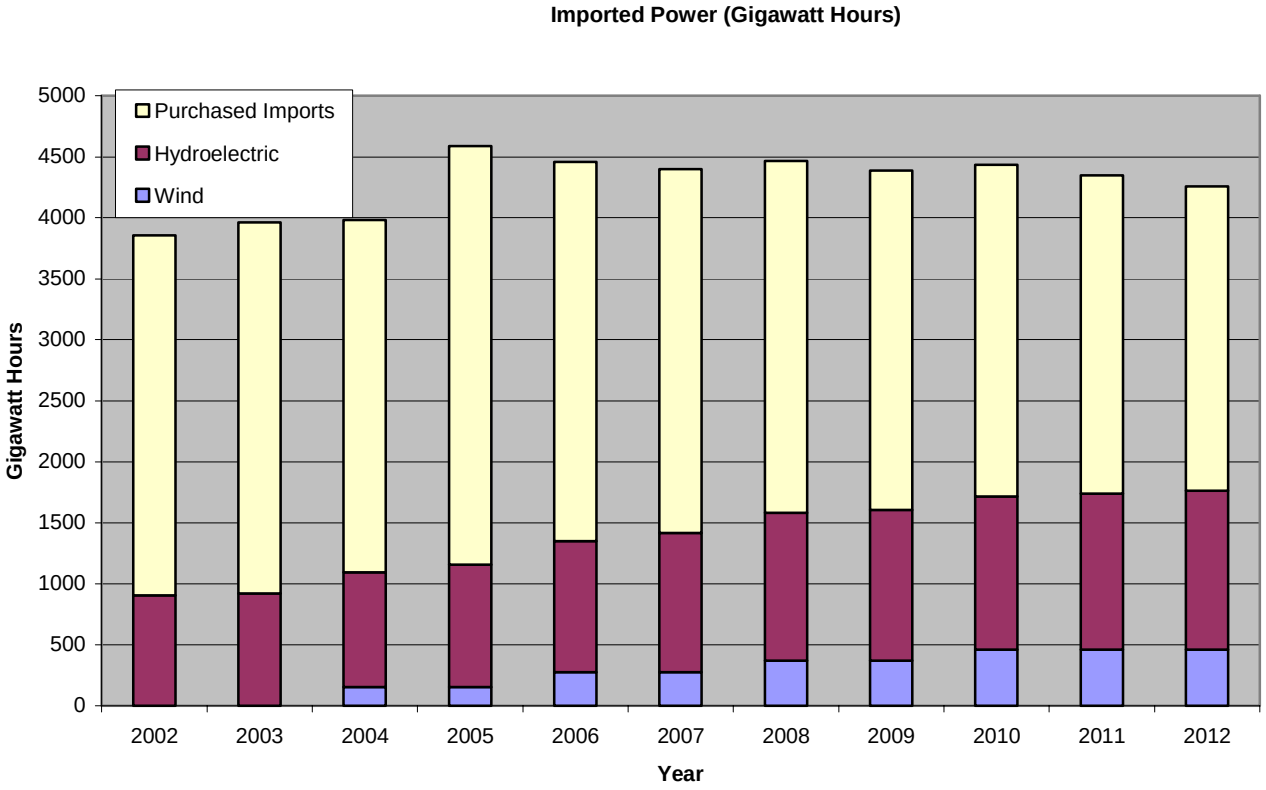


Figure 5.3

Emissions

Figures 5.4 and 5.5 show the impact of local emissions of oxides of nitrogen (NOx) and particulate matter (PM10) of the recommended San Francisco Electricity Resource Portfolio[7]. A vast improvement in reduced emissions is achieved with the retirement of the Hunters Point and Potrero power plants in 2005 and 2006. Emissions begin to increase slightly after 2006 with the addition of cogeneration and distributed generation in the City, which displaces imported power.

[6] The renewable percentage of imported power would be 48% including Hetch Hetchy hydroelectric power, 18% excluding it.

[7] Emission estimates for figures 5.4, 5.5, 5.6 and 5.7 by Rocky Mountain Institute, SFE and SFPUC staff based on data from BAAQMD, PG&E, Mirant, CEC, EPA and California Air Resources Board (CARB).

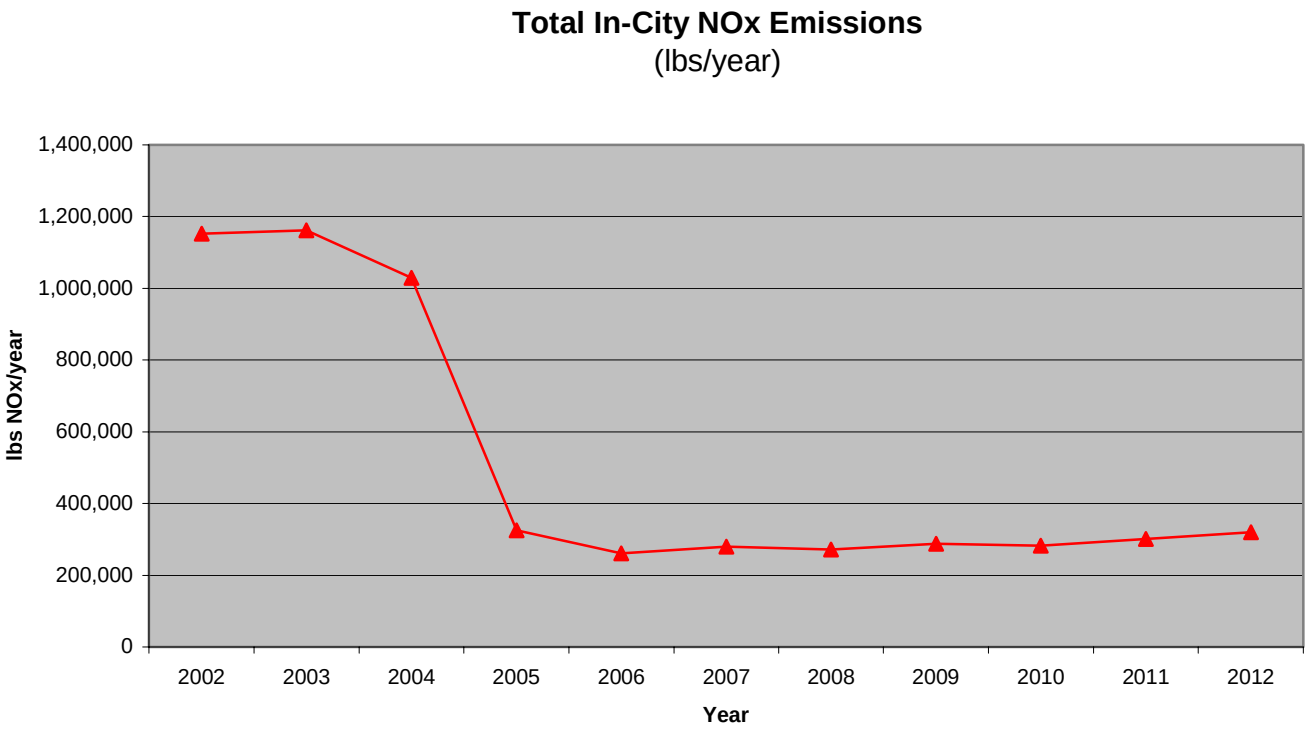


Figure 5.4

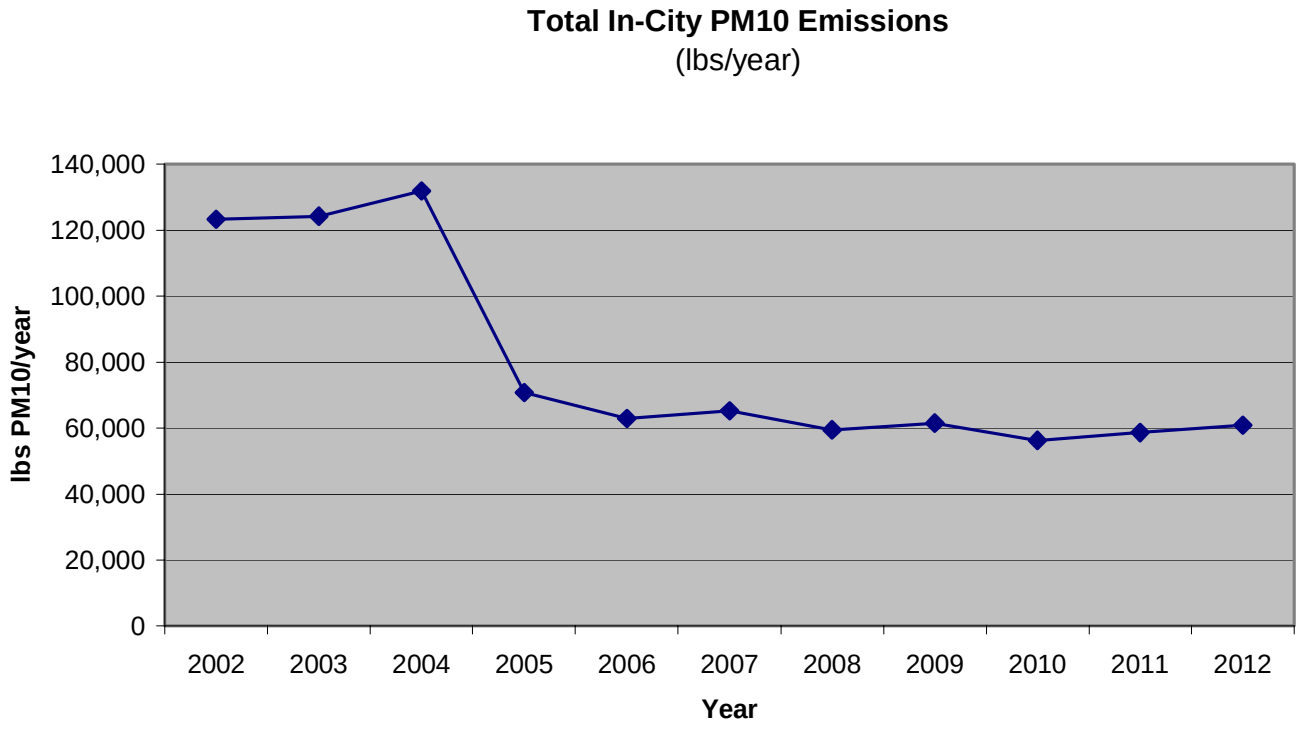


Figure 5.5

Figures 5.6 and 5.7 show the impact of the recommended SF Resource Portfolio on the emission of carbon dioxide (CO2), the most common of greenhouse gases. By 2012 carbon dioxide emissions are reduced by 39% below their 2003 level. A significant amount of the reduction comes the retirement of the Hunters Point and Potrero power plants. Additional reductions are achieved by the increased proportion of imported power coming from renewable sources of electricity, which has reached 18% by 2012 [8]. Reductions in CO2 emissions are also gained through growth in energy efficiency.

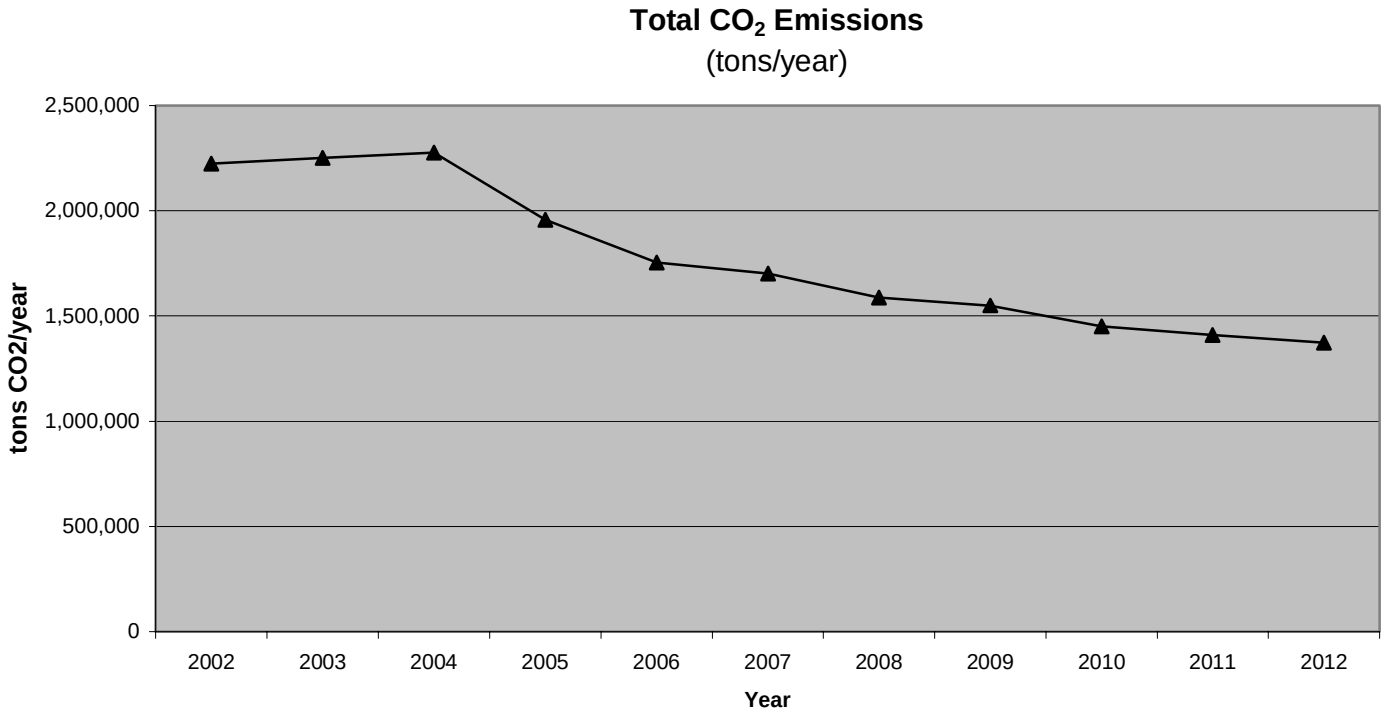


Figure 5.6

[8] The renewable percentage of imported power would be 48% including Hetch Hetchy hydroelectric power, 18% excluding it.

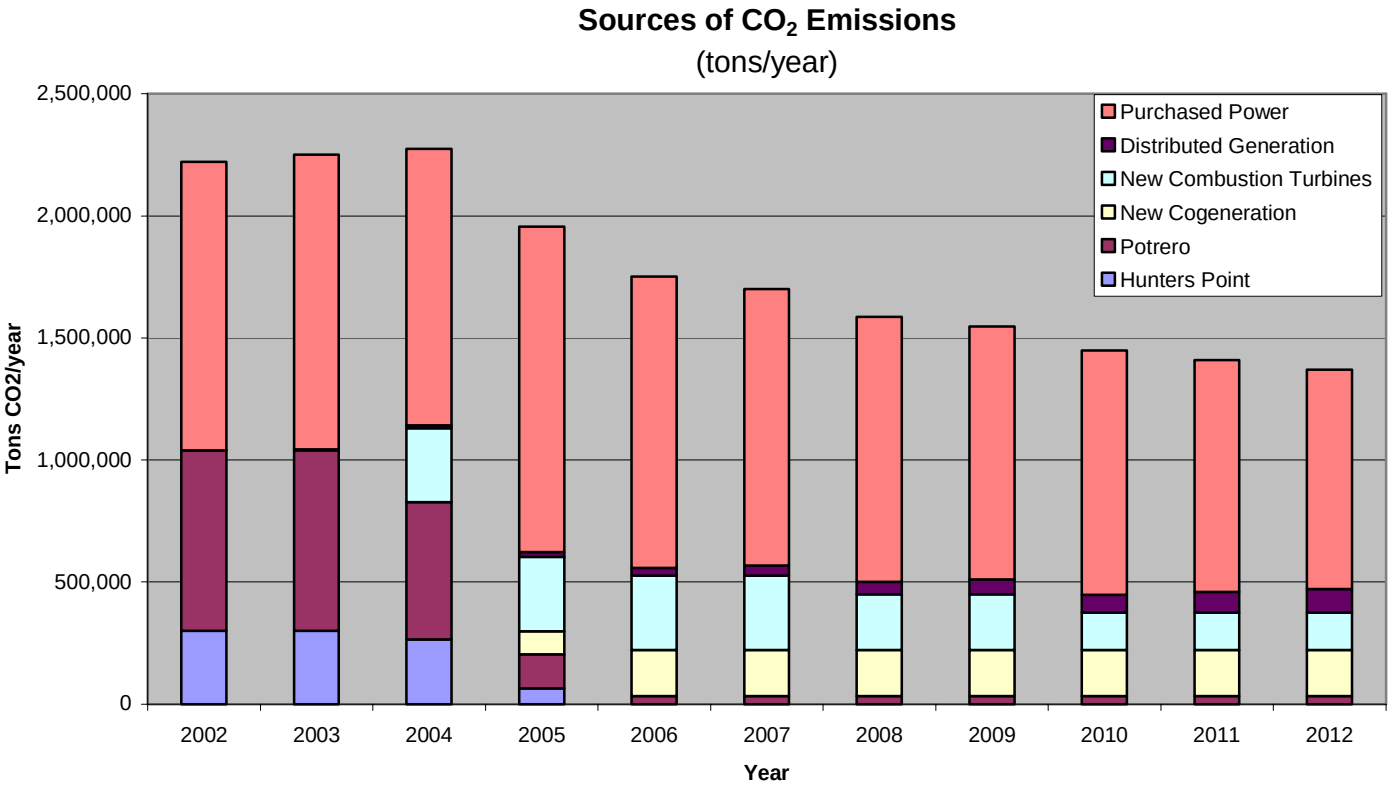


Figure 5.7

Long Term Action Plan - 2012 through 2030

The long-term challenge facing San Francisco in the energy sector is making electricity generation sustainable by maximizing energy efficiency and the use of renewable energy. This means the City will need to increase annually the proportion of electricity being produced through renewable resources while managing both peak and overall consumption of electricity. Because many renewable energy resources are intermittent in nature, it will be important for San Francisco to develop cost-effective electricity storage technologies that will allow electricity to flow at times when the sun, wind, or tidal currents are not capturing energy. It will also be necessary to promote clean energy carriers such as hydrogen that can be used cost-effectively in energy conversion technologies like fuel cells, reciprocating engines and microturbines. Actions that need to be taken in this time frame include:

Phasing out fossil fuel sources of generation in the City

- Attracting private capital for the development of new renewable energy technologies
- Strengthening regulations and incentives to encourage the development of zero net energy buildings and investments in the upgrade of existing buildings
- Building the institutional and human capacity to support the long-term growth and development of sustainable energy in our economy.
- Supporting research in emerging renewable technologies such as wave energy, tidal/marine currents, ocean thermal energy conversion, salinity gradient/osmotic energy, and marine biomass fuels.
- Establishing regional partnerships for the development of renewable resources

Resources to Be Developed

In each program area, SFE and SFPUC will engage specific market sectors by meeting with stakeholders to develop more effective programs. Stakeholders will assist in defining the market barriers, selecting the best options to overcome the barriers, and doing outreach to potential program participants.

Energy Efficiency

Energy Efficiency is our most readily available, cost-effective, and underutilized resource. In a study[9] recently commissioned by PG&E to determine the potential for energy savings in the commercial sector throughout its service area, it was shown that an estimated 13 percent[10] of the peak demand in the commercial sector could be reduced on a cost-effective basis.

The study estimates that well-designed energy efficiency programs can cost effectively realize 80 percent of the electricity savings that is potentially available. The study estimates that PG&E achieved 46 percent of the maximum achievable savings for lighting and air conditioning in 2000. Stronger and more focused programs have the potential to achieve larger savings in the future.

In City facilities, SFPUC is continuing energy efficiency programs that include replacing old equipment with high efficiency equipment; educating City departmental staff; promoting the use of Energy Star-certified computers, lighting, and office equipment; and monitoring heating and air conditioning temperatures. It expects to reduce the peak by 4 megawatts by 2004. For new City facilities, SFE is recommending adoption of a new environmental standard that will require projects to exceed state standards.

In the private sector, energy efficiency needs to be accomplished citywide and address both usage as well as peak load; however, the peak is of primary concern, particularly to address the 2004-5 period and to shut down the Hunters Point plant.

[9] Commercial Sector Energy Efficiency Potential Study, Xenergy Inc., July 2002.
[10] 13% reduction from peak is approximately 113 MW of the January 10, 2001 peak.

Commercial and industrial users contribute most to the summer peak, which occurs in mid afternoon when residential use is typically low. In particular, downtown buildings are a priority. The ISO states that there must be sufficient in-city generation to meet the downtown network load in the event of a transmission failure; therefore, every megawatt reduction in the downtown network reduces the need for a megawatt of in-city generation. New construction is the largest source of expected growth in demand. Because energy efficiency in new construction is the cheapest available energy resource, this should be a very high priority program area. Peak load reductions will mean employing a range of specialized efficiency technologies, e.g. thermal energy storage. Both SFE and SFPUC have begun working with private sector developers by providing design and technical support to help them integrate sustainable and efficient features into the new complexes.

Additionally, there are over 40,000 small businesses in San Francisco that also provide an opportunity for peak demand reductions even though they represent only about 20% of the commercial energy use. Typically, they are tenants in older buildings, and cannot afford updating the building systems; therefore, the lighting, ventilation and refrigeration systems are older and less efficient than those in larger businesses. SFE is currently managing a $7.8 million retrofit program (funded by the state through the CPUC) to install energy-efficient lighting in 4000 small businesses, with a goal of reducing peak demand by 6 megawatts.

San Francisco also experiences a winter peak, which occurs in the evening hours. This is due to the use of electric heating in City apartments and homes, as well as increased lighting due to the shorter days. Targeted residential programs will need to be implemented to address the winter peak, which in some instances has been equal to or even surpassed the summer peak.

Mid-Sized Natural Gas-Fueled Generation
(Replaces Old Large and Mid-Sized Power Plants)

Power plant efficiency has increased significantly with the application of aero derivative combustion turbines. Jet engines that were developed for commercial aircraft have been used in power applications for over 20 years. These plants are more efficient[11] than conventional power plants and perform well with availability rates[12] of around 98 percent. They are operationally flexible with short start up times and can be ramped up

[11] Efficiency is measured by how much of the heat value contained within a fuel can be converted to electric energy. Conventional boiler-steam turbine power plants have efficiencies around 30 percent. Combustion turbines have efficiencies around 35 percent and in a combined cycle mode have efficiencies around 50 percent. In a cogeneration application 80 percent of the energy contained in the fuel can be converted to useful energy usually in the form of steam and electricity. Efficiency is often measured as a heat rate. Heat rates are expressed in terms of the numbers of BTUs of heat needed to produce a kilowatt-hour of electricity. The heat rate for aero derivative combustion turbines is around 10,000 BTUs.

[12] Availability rate means the percentage of the time the plant runs when it is called upon to run. Capacity factor means amount of electricity a plant produces divided by its theoretical maximum production capability for a period of time.

and down to meet power load on a daily basis. With water injection for control of oxides of nitrogen (NOx) and selective catalytic reduction (SCR) systems, they can achieve NOx emission rates that are at least five times less than is required by the SIP for the Clean Air Act.

Combined cycle power plants that use the waste heat from a combustion turbine to produce steam have reached efficiencies exceeding 50 percent and now operate producing less than two parts per million of NOx. Highly efficient and operationally flexible combustion turbines powered by natural gas can be developed at various sites in San Francisco by 2004 if a consensus is achieved as to appropriate sites.

Mid-Sized Cogeneration

(Replaces Old Large and Mid-Sized Power Plants)

Cogeneration is the production and use of electricity and heat from a single installation. Starting in the late 1970's, cogeneration plants have been sited primarily at industrial sites and the power is used on site to reduce energy costs.

One site currently under consideration is a 50-megawatt cogeneration plant at 5th and Jessie Streets in the City. This installation would produce steam to feed into a district heating system, with the electricity being produced as a by-product of the production of steam. The City currently has a steam franchise agreement with NRG Thermal Corporation that produces steam at the 5th and Jessie facilities. The new plant could produce 90 percent of the steam requirement and reduce air emissions by significant amounts compared to a new combined cycle power plant and the boilers necessary to provide the steam for the downtown heating system. A key issue in moving forward on the development of this facility is determining who would purchase the electrical output of this facility and how it would be distributed to retail consumers.

Another potential site for a cogeneration system is the Mission Bay campus of the University of California, San Francisco. The University of California has experience with cogeneration plants at six of its campuses including a 43 megawatt facility at UCLA. That plant provides heat during the winter months and air conditioning through a central chilled water plant and a chilled water distribution loop.

The potential for district heating at Mission Bay is substantial. However, the build-out of the site is a long-term process that creates problems in determining the appropriate size for a cogeneration plant. A larger plant would be more efficient and cost effective. However, sizing a plant larger than the electric requirements of the campus would require that there be a retail market for the surplus.

Over the last 15 years, smaller cogeneration projects have been installed at hospitals, swimming pools, and other facilities that have needs for heating and cooling. The City is currently developing a five megawatt project at San Francisco General Hospital. The commercial market for this equipment continues to be viable; however, there is

opportunity for the City to stimulate further investments through informational programs, direct technical assistance, permitting assistance, and low interest financing via Proposition H.

Renewables

Renewable energy options currently available to the City include solar, wind, biomass, and geothermal. Emerging renewable technologies like wave, tidal current, and ocean thermal energy may be available in the near future. Each of these resources has unique opportunities, advantages, and sometimes disadvantages.

Solar

Solar power is an excellent distributed resource because of its modularity. It can be sized all the way from multi-megawatt systems down to hundreds of watts on residential roofs. Typically, solar electric systems use photovoltaic material to generate electricity directly. Photovoltaic systems are well suited to commercial and institutional settings (schools, hospitals, libraries, government buildings). However, electricity production is dependent on sunlight. Clouds, fog and shading limit the amount of power that a system produces. Solar is, however, particularly valuable when used at the local level to reduce peak power usage and to defer distribution infrastructure development.

The City's first large solar power development will be at the Moscone Center. With approximately 90,000 square feet of perfectly flat unshaded roof, this football-field sized showpiece will significantly reduce Moscone's purchase of power and provide a solar showplace for visitors from all over the world.

The SFPUC has installed radiometers at eleven sites on City buildings and schools to collect data about the availability of sunlight. The variability in solar incidence is based on microclimate and geography, and when cross-referenced with availability of appropriate space, limits the application of solar technologies in some areas of the City. To develop a well thought-out strategy of implementation, the City needs to understand the resource and develop it where it is most cost effective. If sufficient participation by commercial and residential customers is obtained, at least 50 megawatts of solar could be installed in San Francisco. Price of systems is a major consideration in achieving this magnitude of installation. A sustained program to develop solar in San Francisco can help reduce the overall cost of solar technologies.

Wind

Wind has been used for centuries to create mechanical power for uses such as water pumping and the milling of grain. In recent years, wind turbines have been developed that produce electricity. The technology is now well developed, and can be used to generate significant amounts of relatively low-cost power. Modern wind turbines have increased in size and output to megawatt scale machines. San Francisco could obtain significant amounts of wind power in areas such as the Altamont Pass, where wind speeds are high and other conditions like proximity to transmission can be met. The SFPUC is currently

looking at several sites including those adjacent to its own Bay Area reservoirs. The estimated potential for wind development in the greater Bay Area for San Francisco's use could exceed 150 megawatts. Electricity from these projects would require transport using PG&E's transmission lines. There may be additional opportunities for developing small-scale wind projects in the City itself.

Biomass

The combustion or gasification of wood, agricultural waste, and other forms of biomass offers options for San Francisco. The SFPUC is currently reviewing several potential biomass projects. Last year the SFPUC installed a small reciprocating engine to use biogas recovered from the Oceanside Water Treatment Control Plant. This year a 2 MW biogas plant will be operating at the Southeast Water Treatment Control Plant. Both of these plants use methane gas produced by the sewage that would otherwise be flared-off.

Fuel Cells

Fuel cells are a developing technology that is expensive and not yet readily available. Fuel cells do not burn fuel; they chemically convert it, much like a battery chemically stores electricity. Fuel cells need hydrogen and produce water and heat, though current models use the hydrogen contained in natural gas or gasoline because those fuels are readily available. As this technology becomes mass-produced and the cost declines, fuel cells will become a popular option because there are essentially no air emissions.

Marine Energy

Surrounded on three sides by water, San Francisco has enormous technical potential for marine energy technologies. The energy of the ocean is stored partially as kinetic energy from the motion of waves and currents and partly as thermal energy from the sun. Although most marine energy is very diffuse, in special situations it could be cost effectively captured for practical use. Among the marine energy technologies that are currently being investigated are those that convert the energy in waves, tidal/marine currents, ocean thermal gradients, salinity gradients and marine biomass fuels. Tidal and marine current is one of the most serious of the marine energy resources to be studied. The technologies are in development with demonstration projects now being installed in Europe, Canada, and the U.S. The City will initiate partnerships with appropriate agencies to develop demonstration projects.

Geothermal

Geothermal energy has been used commercially for over 70 years both for electricity generation as well as direct use. A significant area of geothermal development has been the Geysers region in Northern California. More recently large-scale geothermal development is taking plant around the Salton Sea in Southern California. Several geothermal developers have approached the city with competitive offers for power purchase agreements. A challenge for San Francisco in utilizing geothermal energy is arranging for cost-effective transmission into the city.

Transmission

In 2002, the ISO issued a finding that the proposed Jefferson to Martin 230 Kv transmission line is needed no later than 2005. However, before the transmission line can be built, PG&E will need to obtain a certificate of convenience and necessity from the CPUC. As part of the certification the CPUC will have to evaluate the environmental impacts of the project under CEQA. The CPUC also has to determine whether the project is the most cost effective way of improving electric system reliability. If it makes that determination, then the cost of the project is placed into PG&E's ratebase and charged over time to all of PG&E's ratepayers, not just those in San Francisco.

Relying on transmission means that the city may be importing power that creates pollution in other communities. If the City is to meet its greenhouse gas reduction commitment it must also reduce the proportion of imported power coming from fossil fuel sources. The City could own or contract for renewable resources from other regions such that the new transmission line would be "importing" green power. In fact, the energy will be coming from the mix on the grid, but by owning or contracting for that power, the City will be supporting the development of renewable energy in the state. Finally, Peninsula loads reduce the amount of power that can be transmitted to San Francisco; therefore, an additional strategy to increase transmission into San Francisco is to encourage efficiency and new generation projects throughout the Peninsula.

Given this linkage between the City's needs and the Peninsula cities, the City should initiate contact with those cities to explore how San Francisco might help stimulate a larger effort towards efficiency and local generation projects on the Peninsula, e.g. via collective purchasing of distributed generation equipment to get better prices.

Funding and Development Options

The City is examining a variety of ways of becoming involved in the generation of renewable and distributed power. It is likely that a combination of these would be considered, including:

- Full ownership, where the City would finance and own the facilities
- Part ownership, where the City would take an equity position and partner with a developer
- Build-own-operate-transfer arrangements, where a developer finances and operates the facility in return for a power purchase agreement and then transfers ownership of the facility to the City at the end of the power purchase agreement
- Straight power purchase agreements, where the City signs an agreement to purchase power and the developer continues to own and operate the system.
- Facilitating private activity through permitting, incentives and technical assistance.

An important issue associated with the use of small-scale distributed generation involves the impact of multiple sources of generation on the operation of the power grid. The distribution system was designed to have a central plant with the power delivered through lines that decrease in voltage as they get further from the source. Distributing the generation onto this system may place generators such that they upset the balance of the system, and cause power to back feed through equipment not designed to operate in that manner. Since the grid was planned for large centralized plants, the control of the system tends to be top-down whereas with many smaller sources interconnected throughout the system, the issue of control becomes more important.

Understanding the impact of multiple sources on the flow of electricity and implementing intelligent two-way controls are crucial to the success of distributed generation in the City. Therefore, distributed resources require that the City work with the utility to resolve the safety, interconnection, and environmental issues that have tended to dominate the distributed generation field in recent years. PG&E and the ISO have agreed to analyze several possible scenarios for planned and potential siting of distributed generation facilities.

6 Findings and Recommendations

The San Francisco Public Utilities Commission (SFPUC) and the Department of the Environment (SFE) submit the following recommendations to support the implementation of an Electricity Resource Plan for San Francisco. In Ordinance 124-01, passed in May 2001, the Board of Supervisors called for plans to implement all practical transmission, conservation, efficiency, and renewable alternatives to fossil fuel generation in San Francisco.

The recommendations are based on findings determined after detailed research and evaluation of San Francisco's electric resources, nine public hearings, several energy forums, consultation with state energy policy makers about California's electricity market and regulatory structure, as well as information obtained from monitoring the progress of proposed projects affecting San Francisco's electricity supply, including the licensing of a new power plant at Potrero.

I. A Clean, Reliable Electricity Portfolio

A. FINDINGS

San Francisco's electric reliability remains vulnerable. Regulatory requirements and limitations continue to pose significant challenges in maintaining adequate reliability while improving air quality and public health. The following have been found to contribute to this situation:

1. A. 1 San Francisco relies heavily on two aging, inefficient, and polluting power plant at Hunters Point and Potrero. The State Implementation Plan for the federal Clean Air Act requires that the owners of these plants significantly reduce emissions of oxides of nitrogen (NOx), a precursor of ground level ozone (smog) by January 1, 2005. Installing new pollution control technology on either of the plants would cost the owners and ratepayers tens of millions of dollars and could result in the extension of their operation for another ten to fifteen years. The installation of the pollution control equipment in 2004 would require the shutdown of the main generators at each plant for three to six months, creating a major reliability problem as well as increased pollution if diesel-fueled peaking power plants are called into operation.

1. A. 2 Analysis by the SFPUC and SFE demonstrate that retrofitting and continuing operation of both these old, large units would produce higher levels of pollution and health impacts than if they were replaced with new, cleaner technologies. Also, smaller-scale, distributed generation, including

co-generation, can more easily be combined with renewables, energy efficiency, and peak load management to minimize the use of fossil fuel generation. The analysis further indicates that reliability would also be enhanced by distributed, mixed resources.

1. A. 3 The City and the residents of Southeast San Francisco have made it clear that they want to shut down, rather than upgrade the Hunters Point plant. In order to close Hunters Point and to meet demand forecasts, there is a need for a projected 100-210 megawatts of in-City replacement generation and load reduction, or new transmission, by 2005. That need grows to 249-317 megawatts by 2012.

1. A. 4 Development of a proposed new 540 MW power plant (Unit 7) at the Potrero facility has been delayed in the regulatory review process and is now looking doubtful due to investors' current lack of confidence in the electricity market. It is now certain that the plant will not be operational by 2005 in time to provide the replacement power needed for the shutdown of Hunters Point.

1. A. 5 San Francisco has transmission constraints that limit the amount of imported power. New transmission projects can increase the amount of power to be imported and limit the hours that in-City power plants need to operate. One project, the upgrade of the San Mateo to Martin line number 4 from 60 kV to 115 kV could be completed before the end of 2004. A new 230 kV transmission line from the Jefferson substation in San Mateo County to the Martin substation would provide another 350 MW of imported power to the City. The current schedule for completion of this transmission project is September 2005. However, it is possible that this project could be delayed.

1. A. 6 There is significant untapped potential for electricity load reduction through energy efficiency improvements and load management in existing buildings and new construction in both the public and private sectors. Energy efficiency investments reduce peak demand, thus avoiding the need to obtain the power from generating plants. Some projects have been identified and could be undertaken immediately. To be fully effective in addressing reliability in 2004-5, additional mechanisms for capturing this potential in a timely fashion would need to be developed.

1. A. 7 There is demonstrable public support and opportunities for the development of solar, wind, and other renewable resources in and near San Francisco. A portfolio of electricity resources that includes an increasing proportion of renewables together with higher levels of energy efficiency can significantly reduce emissions of carbon dioxide and air

pollutants, improve marine and wildlife habitats, lower noise levels, lessen visual impacts, and make a contribution to improved public health.

1. A. 8 Small-scale renewable projects stimulate local economic development to a greater degree than do large-scale generation and transmission approaches, which tend to send most dollars out of the City. Renewables, together with other small-scale distributed generation, such as packaged co-generation and fuel cells, are appropriate applications for many public or commercial facilities in the City.

I. A Clean, Reliable Electricity Portfolio
B. RECOMMENDATIONS

The City should take on the responsibility of planning and developing new electricity demand reduction sources and the most environmentally friendly power generation for San Francisco. This would require that:

1. B. 1 The City periodically review and set annual targets for increasing the efficiency of electricity use and the amount of electricity produced by renewable sources of energy so that ultimately all of San Francisco's electricity needs are met with zero greenhouse gas emissions and minimal impacts on the environment.

1. B. 2 The City identify and promote common criteria for investments in energy efficiency, renewable energy, and fossil fuel powered generation. SFE will develop an economic value for public health and environmental impacts to be incorporated into the investment criteria.

Through coordination with the Independent System Operator, PG&E and others, the City needs to determine more precisely the quantity of new power resources necessary to shut down the Hunters Point Power Plant Unit 4 by 2005 and avoid the retrofit of Potrero Power Plant Unit 3. Based on this coordinated determination of need, the City should develop a mix of efficiency, renewables, small- and mid-scale sources of generation--including co-generation facilities and gas-fired peaking power plants--and facilitate the construction of additional transmission capacity. Specifically,

Energy Efficiency – 16 MW by 2004; 55 MW by 2008; 107 MW by 2012

1. B. 3 The Department of the Environment should facilitate comprehensive energy efficiency implementation measures throughout the private sector, and the San Francisco Public Utilities Commission should aggressively implement energy efficiency projects in City facilities.

1. B. 4 SFE and SFPUC should perform an energy use study of San Francisco's commercial and residential buildings. Results of this study will be used to design targeted electricity demand reduction programs based on San Francisco's unique energy use characteristics.

1. B. 5 The Board of Supervisors should direct City agencies to develop guidelines, programs, and new codes designed to reduce demand in commercial and residential buildings in the public and private sectors. This should include: upgrading the Residential Energy Conservation Ordinance, re-instating the Commercial Energy Conservation Ordinance, and requiring City vendors to participate in energy efficiency programs.

1. B. 6 The Board of Supervisors should adopt energy-efficient planning and building codes for new construction and major renovation projects in the public and private sectors (e.g. requiring district heating and cooling systems in new developments) and join other cities in adopting green building standards such as LEED (Leadership in Energy and Environmental Design).

1. B. 7 A priority target for reduction is the peak demand among commercial and industrial facilities, particularly downtown buildings. SFE and SFPUC should work with downtown building owners and operators and the ISO to implement programs that incentivize load curtailment and load shifting during periods of peak demand.

1. B. 8 SFE and SFPUC should work with other City departments, PG&E, and state and federal agencies to provide enhanced incentives to San Francisco businesses and residents for energy efficiency and peak load reduction (e.g., tax credits, rebates, rate incentives, and peak load management programs).

1. B. 9 SFE should create a coordinated outreach program directing residents and businesses to available local energy efficiency services, local appliance suppliers, programs offered through PG&E and other organizations receiving Public Goods Charge funding, state and federal programs, and tax credits.

1. B. 10 SFPUC should implement a design review program to make new municipal construction projects more energy efficient than required by state and local codes.

1. B. 11 The SFPUC should continue to implement municipal energy efficiency programs in City buildings including large scale retrofits, energy management, recommissioning projects, maintenance, and staff training programs for existing facilities.

1. B. 12 SFE and SFPUC should organize energy efficiency training for operations and maintenance staff, facility managers, and designers/specifiers in both the public and private sectors.

1. B. 13 SFE should develop energy educational programs for schools, coordinating with successful national and state curricula programs. These should be integrated into the curriculum in the SFUSD, City College, as well as private schools and professional training programs.

Renewable Energy – (Solar) 7 MW by 2004; 28 MW by 2008; 50 MW by 2012
(Wind) 50 MW by 2008; 150 MW by 2012

1. B. 14 SFE and SFPUC should identify locations for the installation of renewable energy systems in San Francisco on public and private buildings, and develop programs and funding mechanisms to put them in place through propositions B and H and other sources.

1. B. 15 SFE and SFPUC should work with City Planning and the Department of Building Inspection to facilitate permitting and inspections of renewable energy projects.

1. B. 16 The SFPUC should develop renewable energy sources to be conveyed through transmission lines that serve San Francisco.

1. B. 17 SFE and SFPUC should work with other City departments to develop a local solar installation industry and bring renewable energy manufacturing and assembly to San Francisco.

1. B. 18 The City, through the Board of Supervisors, should set targets for the quantity of solar and other renewable energy development in San Francisco over the next decade.

1. B. 19 The Board of Supervisors should set a Renewable Portfolio Standard that would continually increase percentages of renewables in San Francisco's imported electricity mix (to be supplied by renewable sources such as wind, solar, low-impact hydroelectric, geothermal and biomass). The Board should support Renewable Portfolio Standard legislation at the state and federal levels.

1. B. 20 SFE and SFPUC should develop resources and infrastructure for the production of hydrogen as a fuel to convert or displace fossil fueled technologies.

1. B. 21 SFE and SFPUC should seek partnerships with government agencies and private entities to explore the potential of advanced renewable technologies appropriate for San Francisco's urban environment, including wind, tidal current, and wave generation.

Medium-sized Generation/Co-generation – 150 MW by 2004; 250 MW by 2008 (replaces old fossil fuel generation)

1. B. 22 The City should expeditiously develop sufficient highly efficient and operationally flexible new generating resources to enable the closure of Hunters Point Unit 4 by the end of 2004. The amount of new generation needs to satisfy ISO reliability requirements based on objective load flow analyses.

1. B. 23 The City should facilitate the early retirement of Potrero Unit 3, to avoid costly upgrades and the extended operation of this outdated plant. New City power facilities used as replacement power must reduce air emissions.

1. B. 24 The City should develop cost-effective co-generation applications at locations such as Mission Bay as an effective way of reducing the emission of greenhouse gases and improving electric system reliability.

1. B. 25 The quantity of new natural gas-fired generation procured by the City should be based on an ISO-reviewed load flow study that determines the amount of power necessary to maintain system reliability while complying with all state and federal environmental regulations. All studies will be based on the latest ISO-accepted electricity demand forecast. Whenever investment in demand-side management programs and sustainable resources can offset new fossil fuel development to meet demand forecasts, this will be the City's preferred course.

1. B. 26 SFE and SFPUC should annually evaluate the need to operate any city-owned or controlled natural gas-fired generation. The evaluation will include an assessment of the latest electricity demand forecast and an assessment of the progress in energy efficiency, demand reduction, distributed generation, and renewable energy. Fossil fuel plants should only be used to serve city load and to meet reliability requirements as required by the ISO.

Small-Scale Distributed Generation – 10 MW by 2004; 38 MW by 2008; 72 MW by 2012

1. B. 27 SFE and SFPUC should develop or facilitate private and public sector projects for various distributed generation applications including fuel cells, packaged co-generation, and micro-turbines. Emergency diesel generators that do not have the best available pollution control technology should not be used except in genuine emergencies.

1. B. 28 The City should seek to remove economic disincentives within the control of the CPUC for the development of distributed generation projects installed in San Francisco.

1. B. 29 SFPUC should work with PG&E to research and identify the effects of distributed generation on the local distribution system.

1. B. 30 SFE and SFPUC should work with PG&E, City Planning and the Department of Building Inspection to streamline the permitting and interconnection of distributed generation to the grid.

Transmission – 100 MW by 2005; 450 MW by 2006

1. B. 31 The City should advocate for the completion of the 60 kV to115 kV upgrade of the San Mateo-Martin transmission line number four before the end of 2004.

1. B. 32 The City should support the Jefferson-Martin 230kV transmission line project and strongly advocate for a continual increase in the level of renewables in the electricity resource mix transmitted over the grid. SFPUC should work with PG&E to expedite its early approval and construction. SFE should monitor the EIR process to ensure the City's expectations regarding environmental compliance/mitigation issues are met.

II. Environmental Justice

A. FINDINGS

2. A. 1 The neighborhoods of Southeast San Francisco have historically borne a disproportionate burden of environmental and health impacts represented by the Hunters Point and Potrero power plants. At the same time, these communities have not shared in the benefits of jobs and economic development that the electricity generation supports.

2. A. 2 The most pressing issue facing the neighborhoods of Southeast San Francisco is the closure of old polluting power plants and the net reduction of pollution from the generation of electricity in the Southeast.

2. A. 3 Significant potential exists for creating economic and employment opportunities for residents of Southeast San Francisco in the development of renewable energy sources and the expansion of energy efficiency programs.

II. Environmental Justice
B. RECOMMENDATIONS

2. B. 1 SFE and SFPUC will target low-income neighborhoods in San Francisco for the delivery of services and activities related to the development of the economic infrastructure for the efficiency and renewable energy industries.

2. B. 2 SFE should monitor and periodically report on the dispersion of specific energy program benefits to Southeast San Francisco including training, employment, contracting, and business development opportunities.

2. B. 3 SFE should work with other City departments to monitor and periodically report on carbon dioxide emissions, the reduction in air pollutants, and environmental impacts to Southeast San Francisco, the Bay, and sensitive habitats that are the result of electricity use and infrastructure. The results should be used to measure San Francisco's environmental performance.

2. B. 4 The Board of Supervisors should recommend that the Bay Area Air Quality Management District (BAAQMD) install a new air quality monitoring station in Southeast San Francisco.

2. B. 5 The siting of any new fossil fuel generation in San Francisco must demonstrate a significant improvement in air quality and other environmental benefits in addition to cost-effectiveness using cost benefit analysis criteria that includes health and environmental values.

III. Implementation and Review
A. FINDINGS

3. A. 1 In order to follow through on the recommendations made in this plan and to meet the identified goals, sufficient human and financial resources must be put in place. Some programs and projects are already underway, while others must be initiated and funded.

3. A. 2 Successful implementation will require strong continued participation by the public and leadership by the City. The Chamber of Commerce and the business community are cooperating in promoting energy efficiency and distributed generation among their constituents. SFPUC and SFE are actively engaged with state energy agencies, PG&E, and community groups to coordinate efforts and resources in support of our goals.

III. Implementation and Review
B. RECOMMENDATIONS

3. B. 1 SFE and SFPUC should identify specific objectives and develop timelines for the achievement of energy efficiency, renewable energy, and other distributed generation objectives in each district, each sector, and citywide. They should also identify the resources necessary to implement the recommendations of this Electricity Resource Plan

3. B. 2 The Board of Supervisors should determine when City energy policies need to supercede other City policies (e.g. the Residential Guidelines currently disallow solar on historic buildings).

3. B. 3 The City should establish a funding source other than revenue bonds dedicated to private sector energy programs, such as a carbon tax and credit system.

3. B. 4 SFE and SFPUC should perform an economic impact and employment projection analysis of the effects of implementation of this plan

3. B. 5 SFE and SFPUC should target each sector of the San Francisco economy for the inclusion of energy efficiency, renewable energy and distributed technologies. Sectors include, but are not limited to commercial property developers, banks, large office buildings, small office buildings, hotels, warehouses, grocery stores, and apartment buildings.

3. B. 6 All energy efficiency programs should incorporate measures to address natural gas use in addition to electricity use. SFE and SFPUC should coordinate in applying for funding from foundations as well as federal and state funding sources to achieve the goals of the Electricity Resource Plan.

3. B. 7 SFE and SFPUC should provide periodic updates on any developments in the regulatory or electricity industry that bear on this plan and should submit a joint annual report to the Board of Supervisors on achievements and challenges of the energy program. The Plan itself should be evaluated and updated annually.

FILE NO. ORDINANCE NO.

Appendix A

Board of Supervisors Ordinance

[Human Health and Environment Protections for New Electric Generation]

Ordinance adopting minimum requirements for the protection of human health and the environment for any proposal for new electric generation at the Potrero Power Plant in Southeast San Francisco; and requiring all City officials and departments to advocate these requirements, and greater protections, in regulatory proceedings and negotiations regarding the proposal to build a new power plant at the site of the existing Potrero Power Plant; and requiring approval of the Board of Supervisors for any agreement by City officials or departments for new electric generation in Southeast San Francisco.

Note: Additions are *single-underline italics Times New Roman*;
deletions are ~~*strikethrough italics Times New Roman*~~.
Board amendment additions are double underlined.

Board amendment deletions are ~~strikethrough normal~~.

Be it ordained by the People of the City and County of San Francisco:

Section 1. Findings. The Board of Supervisors hereby finds and declares as follows:

(A) The Energy Resources Conservation and Development Commission (California Energy Commission) has recognized Southeast San Francisco as a minority community entitled to environmental justice;

(B) All of the major electrical generating units in San Francisco are located in Southeast San Francisco which includes the Bayview, Hunters Point, Potrero Hill and Dogpatch neighborhoods;

(C) Southeast San Francisco has a disproportionate number of industrial and polluting facilities;

(D) Southeast San Francisco has an extraordinarily high rate of childhood asthma and other serious respiratory diseases;

(E) Fossil fuel generation is associated with pollutants that damage public health;

(F) Oil fueled generation, such as that produced by the Potrero Power Plant Units 4, 5, and 6 known as "Peakers", is potentially more harmful than natural gas fueled generation;

(G) Alternative fuel sources are more protective of the environment and human health than fossil fuel generation;

(H) The City signed an agreement with PG&E calling for the permanent shutdown of the Hunters Point power plant, as determined by the appropriate state and federal regulatory authorities, as soon as the facility is no longer needed to sustain electrical reliability;

(I) The California Independent System Operator has identified transmission upgrades that would assist with providing reliable electricity to San Francisco;

(J) The City has agreed with PG&E to advocate the expeditious development of capacity (generation and/or transmission) which minimizes adverse community and environmental impacts to replace the Hunters Point power plant;

Section 2. Policy. The City and County of San Francisco shall oppose any application for a proposed siting, expansion or development of fossil fuel power generation at Potrero HIll Power Plant in Southeast San Francisco and deny any governmental approval that will facilitate such generation and withhold its approval of any lease, license, permit, easement or other agreement for such facility unless the applicant can demonstrate the following as minimum conditions:

(A) The proposal and the terms and conditions of the approval will reduce potential and actual emissions of criteria, toxic, and hazardous air pollutants from levels that would occur in

Southeast San Francisco from whatever source without the construction and operation of the proposed fossil fuel electric generation project at Potrero Hill Power Plant. For purposes of this section, such levels include emissions from all actual and potential sources that impact Southeast San Francisco, except that the emissions from the Hunters Point power plant shall be deemed to be zero, and the emissions from Potrero Units 4, 5, and 6 shall be calculated on the basis of actual historic annual emissions for each unit;

(B) The proposal will result in a binding, enforceable agreement, to which the City and County of San Francisco is a party, which provides that the Hunters Point Power Plant shall be permanently shut-down as a source of fossil fuel generation by a date certain which shall be no later than 90 days from the initial firing of generation equipment for any new fossil fuel generation at the proposed site;

(C) The proposal will result in a binding, enforceable agreement, to which the City and County of San Francisco is a party, which provides that all existing peaker units at the Potrero Power plant shall be : (1) retrofitted or rebuilt, using the best available pollution control technology (BACT) and (2) used only when (a) Unit 7 is unavailable due to California ISO scheduled maintenance, or emergencies of which the City is notified, in writing (giving notice to the San Francisco Public Utilities Commission, the San Francisco District Attorney and the Clerk of the Board of Supervisors), by the owner/operator of the Plant, including notification of the time estimated to complete the emergency maintenance, or (b) if there is a natural disaster which disrupts the flow of natural gas to the Potrero Power Plant. In the event the peaker units are used, the owners and operators of the Plant shall provide written reports of emissions, as specified by the Department of Public Health, to the City and County of San Francisco.

(D) The proposal will use the least emitting pollution control technology;

(E) The proposal will result in a binding, enforceable agreement to which the City and County of San Francisco is a party, which provides that the existing Unit 3 at the Potrero Power plant

shall be using the least emitting pollution control technology by a date certain which shall be no later than 90 days from the initial firing of generation equipment for any new fossil fuel generation at the proposed site;

(F) The proposal will result in a binding, enforceable agreement, to which the City and County of San Francisco is a party, requiring the shut down of Unit 3 of the Potrero Hill power plant as soon as the facility is no longer needed to sustain electric reliability in San Francisco and the surrounding area and after appropriate regulatory approvals, and further requiring that within one year of permanent shutdown, the decommissioning of Unit 3 of the Potrero Hill power plant and remediation of the site will begin expeditiously;

(G) The Applicant has provided sufficient mitigation to the impacted communities in Southeast San Francisco to offset any adverse social, economic, cultural, environmental, and public health impacts associated with the fossil fuel generation;

(H) The Applicant shall agree to notify the City and County of San Francisco before it seeks to change or modify any permit required to own, operate, or construct the proposed fossil fuel electric generation project at Potrero Hill Power Plant;

Section 3. Approvals. Any agreement by City officials or departments for or related to new electric generation in San Francisco shall require approval of the Board of Supervisors.

Section 4. Energy Resource Plan. The Board of Supervisors, working with the Public Utilities Commission and the Department of the Environment shall, after public hearings, adopt plans by December 1, 2001 to implement all practical transmission, conservation, efficiency, and renewable alternatives to fossil fuel generation in the City and County of San Francisco. Such plans shall be submitted to the Board of Supervisors by January 1, 2002.

APPROVED AS TO FORM:
LOUISE H. RENNE, City Attorney

By: _____
Deputy City Attorney

APPENDIX B: ENERGY GLOSSARY

(Adapted from Glossary on California Energy Commission website)
http://www.energy.ca.gov/glossary

A ACTIVE SOLAR ENERGY SYSTEM -- A system designed to convert solar radiation into usable energy for space, water heating, or other uses. It requires a mechanical device, usually a pump or fan, to collect the sun's energy.

AGGREGATOR -- An entity responsible for planning, scheduling, accounting, billing, and settlement for energy deliveries from the aggregator's portfolio of sellers and/or buyers. Aggregators seek to bring together customers or generators so they can buy or sell power in bulk, making a profit on the transaction.

ALTERNATING CURRENT -- (AC) Flow of electricity that constantly changes direction between positive and negative sides. Almost all power produced by electric utilities in the United States moves in current that shifts direction at a rate of 60 times per second.

ALTERNATIVE ENERGY SOURCES -- See RENEWABLE ENERGY.

ALTERNATIVE FUEL VEHICLE (AFV) -- motor vehicles that run on fuels other than petroleum-based fuels. As defined by the National Energy Policy Act (EPAct), this excludes reformulated gasoline as an alternative fuel.

AMPERE (Amp) -- The unit of measure that tells how much electricity flows through a conductor. It is like using cubic feet per second to measure the flow of water. For example, a 1,200 watt, 120-volt hair dryer pulls 10 amperes of electric current (watts divided by volts).

APPLIANCE EFFICIENCY STANDARDS -- California Code of Regulations, Title 20, Chapter 2, Subchapter 4: Energy Conservation, Article 4: Appliance Efficiency Standards. Appliance Efficiency Standards regulate the minimum performance requirements for appliances sold in California and apply to refrigerators, freezers, room air conditioners, central air conditioners, gas space heaters, water heaters, plumbing fittings, fluorescent lamp ballasts and luminaires, and ignition devices for gas cooking appliances and gas pool heaters. New National Appliance Standards are in place for some of these appliances and will become effective for others at a future date.

B BALANCED SCHEDULE -- A Scheduling Coordinator's schedule is balanced when generation, adjusted for transmission losses, equals demand.

BALLAST -- A device that provides starting voltage and limits the current during normal operation in electrical discharge lamps (such as fluorescent lamps).

BASE LOAD UNIT -- A power generating facility that is intended to run constantly at near capacity levels, as much of the time as possible.

BIOMASS -- Energy resources derived from organic matter. These include wood, agricultural waste and other living-cell material that can be burned to produce heat energy. They also include algae, sewage and other organic substances that may be used to make energy through chemical processes.

BOILER -- A closed vessel in which water is converted to pressurized steam.

BRITISH THERMAL UNIT (Btu) -- The standard measure of heat energy. It takes one Btu to raise the temperature of one pound of water by one degree Fahrenheit at sea level. For example, it takes about 2,000 Btus to make a pot of coffee. One Btu is equivalent to 252 calories, 778 foot-pounds, 1055 joules, and 0.293 watt-hours. Note: In the abbreviation, only the B is capitalized.

C

CALIFORNIA ENERGY COMMISSION -- The state agency established by the Warren-Alquist State Energy Resources Conservation and Development Act responsible for energy policy. The Energy Commission's five major areas of responsibilities are:

1.Forecasting future statewide energy needs
2.Licensing power plants sufficient to meet those needs
3.Promoting energy conservation and efficiency measures
4.Developing renewable and alternative energy resources, including providing assistance to develop clean transportation fuels
5.Planning for and directing state response to energy emergencies

CALIFORNIA PUBLIC UTILITIES COMMISSION (CPUC) -- A state agency created by constitutional amendment to regulate the rates and services of privately owned utilities and transportation companies. The CPUC is an administrative agency that exercises both legislative and judicial powers; its decisions and orders may be appealed only to the California Supreme Court. The major duties of the CPUC are to regulate privately owned utilities, securing adequate service to the public at rates that are just and reasonable both to customers and shareholders of the utilities; including rates, electricity transmission lines and natural gas pipelines. The CPUC also provides electricity and natural gas forecasting, and analysis and planning of energy supply and resources.

CAPACITY (Electric utility) -- The maximum amount of electricity that a generating unit, power plant or utility can produce under specified conditions. Capacity is measured in megawatts and is also referred to as the NAMEPLATE RATING.

CAPACITY FACTOR -- A percentage that tells how much of a power plant's capacity is used over time. For example, typical plant capacity factors range as high as 80 percent for geothermal and 70 percent for cogeneration.

CHILLER -- A device that cools water, usually to between 40 and 50 degrees Fahrenheit for eventual use in cooling air.

COGENERATOR -- Cogenerators use the waste heat created by one process, for example during manufacturing, to produce steam which is used, in turn, to spin a turbine and generate electricity. Cogenerators may also be QFs.

COMBINED CYCLE PLANT -- An electric generating station that uses waste heat from its gas turbines to produce steam for conventional steam turbines.

COMPETITIVE TRANSMISSION CHARGE -- A non-bypassable charge that customers pay to a utility for the recovery of its stranded costs.

CONDUCTIVITY (k) -- The quantity of heat that will flow through one square foot of homogeneous material, one inch thick, in one hour, when there is a temperature difference of one degree Fahrenheit between its surfaces.

CONGESTION -- A condition that occurs when insufficient transfer capacity is available to implement all of the preferred schedules simultaneously.

CONSERVATION -- Steps taken to reduce energy use. These steps involve changing behavior patterns to reduce consumption, such as turning off equipment and appliances when not in use. “Energy Efficiency” means using less energy/electricity to perform the same function, by upgrading equipment. These terms are sometimes used interchangeably.

CONVECTION -- Transferring heat by moving air, or transferring heat by means of upward motion of particles of liquid or gas heat from beneath.

COOLING TOWER -- A device for evaporatively cooling water by contact with air.

D

DAY-AHEAD SCHEDULE -- Day-ahead Schedule A schedule prepared by a Scheduling Coordinator or the ISO before the beginning of a trading day. This schedule indicates the levels of generation and demand scheduled for each settlement period of that trading day.

DAYLIGHTING --The use of sunlight to supplement or replace electric lighting.

DEMAND (Utility) The level at which electricity or natural gas is delivered to users at a given point in time. Electric demand is expressed in kilowatts.

DEMAND SIDE MANAGEMENT (DSM) The methods used to manage energy demand including energy efficiency, load management, fuel substitution and load building. See LOAD MANAGEMENT.

DIRECT ACCESS -- The ability of a retail customer to purchase commodity electricity directly from the wholesale market rather than through a local distribution utility. (See also Retail Competition)

DIRECT CURRENT (DC) -- Electricity that flows continuously in the same direction.

DISTRIBUTION -- The delivery of electricity to the retail customer's home or business through low voltage distribution lines.

DISTRIBUTED GENERATION -- A distributed generation system involves small amounts of generation located on a utility's distribution system for the purpose of meeting local (substation level) peak loads and/or displacing the need to build additional (or upgrade) local distribution lines.

DISTRIBUTION SYSTEM (Electric utility) -- The substations, transformers and lines that convey electricity from high-power transmission lines to ultimate consumers. See GRID.

E

ENERGY EFFICIENCY -- Using less energy/electricity to perform the same function or obtain the same result. Using electricity more efficiently. Efficiency measures include upgrading lighting, HVAC, motors, and other equipment in order to produce more output (light, heat, power) per unit of input (kilowatts). "Energy conservation" refers to saving energy through changes in behavior rather than permanent energy use reduction through efficiency. These terms are sometimes used interchangeably.

ESCO -- Efficiency Service Company -- A company that offers to reduce a client's electricity consumption with the cost savings being split with the client.

EFFICIENCY -- The ratio of the useful energy delivered by a dynamic system (such as a machine, engine, or motor) to the energy supplied to it over the same period or cycle of operation. The ratio is usually determined under specific test conditions.

ENERGY -- The capacity for doing work. Forms of energy include: thermal, mechanical, electrical and chemical. Energy may be transformed from one form into another.

F

FEDERAL ENERGY REGULATORY COMMISSION (FERC) -- An independent regulatory commission within the U.S. Department of Energy that has jurisdiction over energy producers that sell or transport fuels for resale in interstate commerce; the authority to set oil and gas pipeline transportation rates and to set the value of oil and gas pipelines for ratemaking purposes; and regulates wholesale electric rates and hydroelectric plant licenses.

FIRM ENERGY -- Power supplies that are guaranteed to be delivered under terms defined by contract.

FOSSIL FUEL -- Oil, coal, natural gas or their by-products. Fuel that was formed in the earth in prehistoric times from remains of living-cell organisms.

FUEL CELL -- A device or an electrochemical engine with no moving parts that converts the chemical energy of a fuel, such as hydrogen, and an oxidant, such as oxygen, directly into electricity. The principal components of a fuel cell are catalytically activated electrodes for the fuel (anode) and the oxidant (cathode)

and an electrolyte to conduct ions between the two electrodes, thus producing electricity.

G GEOTHERMAL ENERGY -- Natural heat from within the earth, captured for production of electric power, space heating or industrial steam.

GIGAWATT (GW) -- One thousand megawatts (1,000 MW) or, one million kilowatts (1,000,000 kW) or one billion watts (1,000,000,000 watts) of electricity. One gigawatt is enough to supply the electric demand of about one million average California homes.

GIGAWATT-HOUR (GWH) -- One million kilowatt-hours of electric power. California's electric utilities generated a total of about 270,000 gigawatt-hours in 1988.

GLOBAL CLIMATE CHANGE -- Gradual changing of global climates due to buildup of carbon dioxide and other greenhouse gases in the earth's atmosphere. Carbon dioxide produced by burning fossil fuels has reached levels greater than what can be absorbed by green plants and the seas.

GRID -- The electric utility companies' transmission and distribution system that links power plants to customers through high power transmission line service (110 kilovolt [kv] to 765 kv); high voltage primary service for industrial applications and street rail and bus systems (23 kv-138 kv); medium voltage primary service for commercial and industrial applications (4 kv to 35 kv); and secondary service for commercial and residential customers (120 v to 480 v). Grid can also refer to the layout of a gas distribution system of a city or town in which pipes are laid in both directions in the streets and connected at intersections.

H HEAT RATE -- A number that tells how efficient a fuel-burning power plant is. The heat rate equals the Btu content of the fuel input divided by the kilowatt-hours of power output

HORSEPOWER (HP) -- A unit for measuring the rate of doing work. One horsepower equals about three-fourths of a kilowatt (745.7 watts).

HVAC (Heating Ventilation and Air Conditioning) -- A system that provides heating, ventilation and/or cooling within or associated with a building.

I IMPORTS (Electric utility) -- Power capacity or energy obtained by one utility from others under purchase or exchange agreement.

INSOLATION -- The total amount of solar radiation (direct, diffuse, and reflected) striking a surface exposed to the sky.

INSULATION, THERMAL -- A material having a relatively high resistance of heat flow and used principally to retard heat flow. See R-VALUE.

INTERCONNECTION (Electric utility) -- The linkage of transmission lines between two utilities, enabling power to be moved in either direction.

Interconnections allow the utilities to help contain costs while enhancing system reliability.

IOU -- An investor owned utility. A company, owned by stockholders for profit, that provides utility services. A designation used to differentiate a utility owned and operated for the benefit of shareholders from municipally owned and operated utilities and rural electric cooperatives.

INTEGRATED RESOURCE PLANNING (IRP) -- A public planning process and framework within which the costs and benefits of both demand- and supply-side resources are evaluated to develop the least-total-cost mix of utility resource options. In many states, IRP includes a means for considering environmental damages caused by electricity supply/transmission and identifying cost-effective energy efficiency and renewable energy alternatives. IRP has become a formal process prescribed by law in some states and under some provisions of the Clean Air Act amendments of 1992.

IPP -- INDEPENDENT POWER PRODUCER. An private entity that operates a generation facility and sells power to electric utilities for resale to retail customers.

ISO -- INDEPENDENT SYSTEM OPERATOR. A neutral operator responsible for maintaining instantaneous balance of the grid system. The ISO performs its function by controlling the dispatch of flexible plants to ensure that loads match resources available to the system.

K KILOVOLT (kv) -- One-thousand volts (1,000). Distribution lines in residential areas usually are 12 kv (12,000 volts).

KILOWATT (kW) -- One thousand (1,000) watts. A unit of measure of the amount of electricity needed to operate given equipment. On a hot summer afternoon a typical home, with central air conditioning and other equipment in use, might have a demand of four kW each hour.

KILOWATT-HOUR (kWh) -- The most commonly-used unit of measure telling the amount of electricity consumed over time. It means one kilowatt of electricity supplied for one hour. In 1989, a typical California household consumes 534 kWh in an average month.

L LIFE-CYCLE COST -- Amount of money necessary to own, operate and maintain a building over its useful life.

LOAD -- An end-use device or an end-use customer that consumes power. Load should not be confused with demand, which is the measure of power that a load receives or requires.

LOAD MANAGEMENT -- Steps taken to reduce power demand at peak load times or to shift some of it to off-peak times. This may be with reference to peak hours, peak days or peak seasons. The main thing affecting electric peaks is

air-conditioning usage, which is therefore a prime target for load management efforts. Load management may be pursued by persuading consumers to modify behavior or by using equipment that regulates some electric consumption.

M MARGINAL COST-- The sum that has to be paid the next increment of product of service. The marginal cost of electricity is the price to be paid for kilowatt-hours above and beyond those supplied by presently available generating capacity.

MEGAWATT (MW) -- One thousand kilowatts (1,000 kW) or one million (1,000,000) watts. One megawatt is enough energy to power 1,000 average California homes.

MEGAWATT HOUR (MWh) -- One thousand kilowatt-hours, or an amount of electricity that would supply the monthly power needs of a typical home having an electric hot water system.

MUNICIPAL UTILITY -- A provider of utility services owned and operated by a municipal government.

N NATURAL GAS -- Hydrocarbon gas found in the earth, composed of methane, ethane, butane, propane and other gases.

O OPEC -- Acronym for Organization of Petroleum Exporting Countries founded in 1960 for unify and coordinate petroleum polices of the members. Headquarters is in Vienna, Austria.

OUTAGE (Electric utility) -- An interruption of electric service that is temporary (minutes or hours) and affects a relatively small area (buildings or city blocks).

OZONE - A kind of oxygen that has three atoms per molecule instead of the usual two. Ozone is a poisonous gas, but the ozone layer in the upper atmosphere shields life on earth from deadly ultraviolet radiation from space. The molecule contains three oxygen atoms (O3).

P PARTICULATE MATTER (PM) -- Unburned fuel particles that form smoke or soot and stick to lung tissue when inhaled. A chief component of exhaust emissions from heavy-duty diesel engines.

PASSIVE SOLAR ENERGY -- Use of the sun to help meet a building's energy needs by means of architectural design (such as arrangement of windows) and materials (such as floors that store heat, or other thermal mass).

PEAK LOAD -- The highest electrical demand within a particular period of time. Daily electric peaks on weekdays occur in late afternoon and early evening. Annual peaks occur on hot summer days.

PEAKING UNIT -- A power generator used by a utility to produce extra electricity during peak load times.

PHOTOVOLTAIC CELL -- A semiconductor that converts light directly into electricity.

POWER -- Electricity for use as energy.

PURPA -- The Public Utilities Regulatory Policies Act of 1978 (PURPA) is implemented by the Federal Energy Regulatory Commission and the California Public Utilities Commission (CPUC). Under PURPA each electric utility is required to offer to purchase available electric energy from cogeneration and small power production facilities.

Q

QUAD -- One quadrillion (10^{15} or 1,000,000,000,000,000) British thermal units (Btus). An amount of energy equal to 170 million barrels of oil. Total U.S. consumption of all forms of energy is (in the 1990s) about 83 quads in an average year.

QUALIFYING FACILITY -- A cogenerator or small power producer which under federal law, has the right to sell its excess power output to the public utility.

R

RADIATION -- The flow of energy across open space via electromagnetic waves such as light. Passage of heat from one object to another without warming the air space in between.

RATE-BASING -- refers to practice by utilities of allotting funds invested in utility Research Development Demonstration and Commercialization and other programs from ratepayers, as opposed to allocating these costs to shareholders.

RELIABILITY -- Electric system reliability has two components-- adequacy and security. Adequacy is the ability of the electric system to supply the aggregate electrical demand and energy requirements of the customers at all times, taking into account scheduled and unscheduled outages of system facilities. Security is the ability of the electric system to withstand sudden disturbances such as electric short circuits or unanticipated loss of system facilities.

RELIABILITY MUST-RUN GENERATION -- The ISO will allow power providers to generate power that is needed to ensure system reliability. This includes generation:

- Required to meet the reliability criteria for interconnected systems operation.
- Needed to meet load (demand) in constrained areas.
- Needed to provide voltage or security support of the ISO or of a local area.

RELIABILITY MUST RUN UNIT -- In return for payment, the ISO may call upon the owner of a generating unit to run the unit when required for grid reliability.

RENEWABLE ENERGY -- Resources that constantly renew themselves or that are regarded as practically inexhaustible. These include solar, wind, geothermal, hydro and wood. Although particular geothermal formations can be depleted, the natural heat in the earth is a virtually inexhaustible reserve of potential energy. Renewable resources also include some experimental or less-developed sources such as tidal power, sea currents and ocean thermal gradients.

RESERVE MARGIN -- The differences between the dependable capacity of a utility's system and the anticipated peak load for a specified period.

RESTRUCTURING -- The reconfiguration of the vertically-integrated electric utility. Restructuring usually refers to separation of the various utility functions into individually-operated and -owned entities.

RETAIL WHEELING -- See Direct Access.

S

SELF-GENERATION -- A generation facility dedicated to serving a particular retail customer, usually located on the customer's premises. The facility may either be owned directly by the retail customer or owned by a third party with a contractual arrangement to provide electricity to meet some or all of the customer's load.

SOLAR COLLECTOR -- A component of an active or passive solar system that absorbs solar radiation to heat a transfer medium which, in turn, supplies heat energy to the space or water heating system.

SOLAR CELL -- A photovoltaic cell that can convert light directly into electricity. A typical solar cell uses semiconductors made from silicon.

SOLAR POWER -- Electricity generated from solar radiation.

SUBSTATION -- A facility that steps up or steps down the voltage in utility power lines. Voltage is stepped up where power is sent through long-distance transmission lines. it is stepped down where the power is to enter local distribution lines.

SUPPLY-SIDE -- Activities conducted on the utility's side of the customer meter. Activities designed to supply electric power to customers, rather than meeting load though energy efficiency measures or on-site generation on the customer side of the meter.

T

TARIFF -- A document, approved by the responsible regulatory agency, listing the terms and conditions, including a schedule of prices, under which utility services will be provided.

THERM - One hundred thousand (100,000) British thermal units (1 therm = 100,000 Btu).

THERMAL MASS -- A material used to store heat, thereby slowing the temperature variation within a space. Typical thermal mass materials include concrete, brick, masonry, tile and mortar, water, and rock or other materials with high heat capacity.

THERMODYNAMICS -- A study of the transformation of energy into other manifested forms and of their practical applications. The three laws of thermodynamics are:

1. Law of Conservation of Energy -- energy may be transformed in an isolated system, but its total is constant
2. Heat cannot be changed directly into work at constant temperature by a cyclic process
3. Heat capacity and entropy of every crystalline solid becomes zero at absolute zero (0 degrees Kelvin)

TIME-OF-USE RATES -- Electricity prices that vary depending on the time periods in which the energy is consumed. In a time-of- use rate structure, higher prices are charged during utility peak-load times. Such rates can provide an incentive for consumers to curb power use during peak times.

TRANSFORMER -- A device, which through electromagnetic induction but without the use of moving parts, transforms alternating or intermittent electric energy in one circuit into energy of similar type in another circuit, commonly with altered values of voltage and current.

TRANSMISSION -- Transporting bulk power over long distances.

U UDC -- Utility distribution company. An entity that owns a distribution system for the delivery of energy to and from the ISO-controlled grid, and that provides regulated, retail service to eligible end-use customers who are not yet eligible for direct access, or who choose not to arrange services through another retailer.

V VOLT -- A unit of electromotive force. It is the amount of force required to drive a steady current of one ampere through a resistance of one ohm. Electrical systems of most homes and office have 120 volts.

W WATT -- A unit of measure of electric power at a point in time, as capacity or demand.

WHEELING -- The transmission of electricity by an entity that does not own or directly use the power it is transmitting. Wholesale wheeling is used to indicate bulk transactions in the wholesale market, whereas retail wheeling allows power producers direct access to retail customers. This term is often used colloquially as meaning transmission.

WATT-HOUR -- One watt of power expended for one hour. One thousandth of a kilowatt-hour.